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(54) Method for identification and detection of microorganisms using gyrase gene as an indicator

(57) A method for identifying a microorganism, comprises

(i) amplifying DNA from the microorganism by PCR using two primers, wherein at least one of the said primers comprises sequence which codes for all or part of one of the following amino acid sequences (a) to (l):

- (a) (Pro or Ser)-(Ala or Thr)-(Ala, Val or Leu)-(Glu or Asp)-(Val or Thr)-(Ile or Val)-(Met, Leu or Phe)-Thr-(Val, Gln or Ile)-Leu-His-Ala-Gly-Gly-Lys-Phe-(Asp or Gly)-(Asp, Gly, Asn or Ser)-(Ser, Lys, Gly, Asp or Asn)
- (b) Gly-Gly-Thr-His
- (c) (Ile or Leu)-Met-Thr-Asp-Ala-Asp-Val-Asp-Gly-(Ala or Ser)-His-Ile-Arg-Thr-Leu
- (d) Arg-Lys-Arg-Pro-(Gly or Ala)-Met-Tyr-Ile-Gly-(Ser or Asp)-Thr
- (e) Gln-(Thr or Pro)-(Lys or Asn)-(Thr, Asp, Gly, Lys, Ser, Phe or Tyr)-Lys-Leu
- (f) (Tyr or Phe)-Lys-Gly-Leu-Gly-Glu-Met-Asn-(Ala or Pro)
- (g) Val-Glu-Gly-Asp-Ser-Ala-Gly-Gly-Ser

(h) Lys-(His or Val)-Pro-Asp-Pro-(Gln or Lys)-Phe

(i) Leu-Pro-Gly-Lys-Leu-Ala-Asp-Cys-(Ser or Gln)-(Ser or Glu)-(Lys or Arg)-Asp-Pro-(Ala or Ser)

(j) Gln-Leu-(Trp or Arg)-(Glu or Asp)-Thr-Thr-(Met or Leu)-(Asp or Asn)-Pro

(k) Ala-(Lys or Arg)-(Lys or Arg)-Ala-Arg-Glu

(l) Phe-Thr-Asn-Asn-Ile-(Pro or Asn)-(Thr or Gln)

and which functions as a substantial primer; and  
(ii) identifying the microorganism based on the nucleotide sequence of the amplified DNA fragment.

EP 0 935 003 A2

## Description

[0001] The present invention is involved in a method for the identification and detection of organisms using the sequences of their genes encoding the B subunit of the DNA gyrase.

5 [0002] This invention is useful in medical fields as well as various industrial fields where the identification/classification or detection/monitoring of specific microorganisms (bacteria, yeasts, fungi, archaea and bacteria), especially bacteria, is necessary.

[0003] Conventionally, the identification/classification of living organisms has been carried out using the combination of biochemical and morphological tests. However, these tests often did not provide unequivocal answers to the taxonomic positions of tested organisms.

10 [0004] Recently, the taxonomy of organisms, in particular of bacteria, using rRNA sequences became fashionable. There are many reasons why rRNA molecules have been selected as standard molecules for the molecular taxonomy. They are constituents of all organisms. They exist in abundance, and therefore, can readily be isolated and characterized. For sequence comparison, many conserved regions of rRNA molecules allowed the alignment between distantly related organisms, while variable regions are useful for the distinction of closely related organisms (van de Peer, Y., S. Chapelles, and R. de Wachter. 1996. A quantitative map of nucleotide substitution rates in bacterial rRNA. *Nucleic Acids Res.* 24: 3381-3391; and Gutell, R. R., N. Larsen, and C. R. Woese. 1994. Lessons from an evolving rRNA: 16S and 23S rRNA structures from a comparative perspective. *Microbiol. Rev.* 58: 10-26). Furthermore, there is a few evidence for the horizontal transfer of rRNA genes although many other genes are expected to have frequently been transferred from one species to other distantly related species. At present, rRNA sequences are accumulating rapidly and they are accessible via an international database (Ribosomal Database project, <http://rdp.life.uiuc.edu/>).

20 [0005] However, as is clear from the fact that the evolution speed of rRNA genes is extremely slow, there is little difference in the rRNA sequences between closely related organisms. Therefore, in many times, species belonging to the same genus could not be discriminated by the analysis using rRNA sequences. For example, it is said that bacteria sharing more than 97 % of identity in their 16S rRNA sequences (bacterial small subunit rRNA) might belong to the same species. However, there are cases of bacteria exhibiting more than 99 % identity in their 16S rRNA sequences, and yet belonging to two distinct species as revealed from DNA hybridization analysis. Evidently, due to the slow speed of divergent evolution of the 16S rRNA gene, the resolution of 16S rRNA-based analysis between closely related organisms is lower than that of DNA hybridization analysis (Stackebrandt, E. and Goebel, B. M. 1994. Taxonomic note: a place for DNA-DNA reassociation and 16S rRNA sequence analysis in the present species definition in bacteriology. *Int. J. Syst. Bacteriol.* 37: 463-464).

25 [0006] Other problems exist in the rRNA-based phylogenetic analysis. To establish a phylogenetic relationship based on rRNA sequences, these sequences should be aligned. The alignment of rRNA sequences composed from four different constituents (AUCG), however, is not easy, and requires some expertise. The correct sequencing of rRNA genes is also difficult largely due to their highly ordered structure. Furthermore, polymorphism of rRNA was found in some organisms.

30 [0007] In contrast, protein-encoding genes have evolved more rapidly than rRNA-encoding genes, since they allow the so-called neutral mutations that do not cause any amino acid substitutions in their gene products. It is then expected that, by using such protein-encoding genes, more precise phylogenetic analysis can be performed than by using rRNA sequences. Thus, the present inventors have developed and applied a method for the identification/classification or detection/monitoring of organisms using the sequences of *gyrB* genes encoding the B subunit of DNA gyrases (Yamamoto, S. and Harayama, S. 1995. PCR Amplification and Direct Sequencing of *gyrB* Genes with Universal Primers and Their Application to the Detection and Taxonomic Analysis of *Pseudomonas putida* Strains. *Appl. Environ. Microbiol.* 61: 1104-1109; Yamamoto, S. and Harayama, S. 1996. Phylogenetic Analysis of *Acinetobacter* Strains Based on the Nucleotide Sequences of *gyrB* Genes and on the Amino acid Sequences of Their Products. *Int. J. Syst. Bacteriol.* 46: 506-511; Yamamoto, S. and Harayama, S. 1998. Phylogenetic relationships of *Pseudomonas putida* strains deduced from the nucleotide sequences of *gyrB*, *rpoD* and 16S rRNA genes. *Int. J. Syst. Bacteriol.* 48: 813-819; Yamamoto, S., Bouvet, P. J. M. & Harayama, S. 1998. Phylogenetic structures of the genus *Acinetobacter* based on the *gyrB* sequences: Comparison with the grouping by DNA-DNA hybridization. *Int. J. Syst. Bacteriol.* (in press); Harayama, S. and Yamamoto, S. 1996. Phylogenetic Identification of *Pseudomonas* Strains Based on a Comparison of *gyrB* and *rpoD* Sequences. p. 250-258 in *Molecular Biology of Pseudomonads*, edited by T. Nakazawa, K. Furukawa, D. Haas, S. Silver. ASM Press, Washington, D.C.; and Watanabe, K., Yamamoto, S., Hino, S. and Harayama, S. 1998. Population dynamics of phenol-degrading bacteria in activated sludge determined by *gyrB*-targeted quantitative PCR. *Appl. Environ. Microbiol.* 64: 1203-1209).

35 [0008] DNA topoisomerases are essential for the replication, transcription, recombination and repair of DNA and control the level of supercoiling of DNA molecules by cleaving and resealing the phosphodiester bond of DNA. They are classified into type I (EC 5.99.1.2) and type II (EC 5.99.1.3) according to their enzymatic properties. The DNA gyrase is a type II topoisomerase that is capable of introducing negative supercoiling into a relaxed closed circular DNA mole-

5 cule. This reaction is coupled with ATP hydrolysis. DNA gyrase can also relax supercoiled DNA without ATP hydrolysis. DNA gyrase consists of two subunit proteins in the quaternary structure of A<sub>2</sub>B<sub>2</sub>. The A subunit (GyrA) has a molecular weight of approximately 100 kDa while the B subunit (GyrB) has a molecular weight of either 90 kDa or 70 kDa (Wigley, D. B. 1995. Structure and mechanism of DNA topoisomerases. *Ann. Rev. Biomol. Struct.* 24: 185-208). The genes for DNA gyrase or its isofunctional enzymes should exist in all organisms as they are indispensable for the cell proliferation.

10 [0009] As described above, the present inventors have already developed and applied successfully the method for the identification/classification or detection/monitoring of organisms using *gyrB* sequences. In this method, a *gyrB* gene fragment of an organism of interest is amplified by PCR using primers designed from the two amino acid sequences, His-Ala-Gly-Gly-Lys-Phe-Asp and Met-Thr-Asp-Ala-Asp-Val-Asp-Gly, which are highly conserved among the GyrB sequences of many organisms. Subsequently, the amplified fragments are subjected to direct sequencing. Since the *gyrB* genes code for proteins, they have frequently undergone neutral mutations. Thus, the nucleotide sequence of the *gyrB* genes vary considerably even among related organisms. For this reason, the above method has been shown to be effective for discriminating organisms at a level of species of subspecies. The above-mentioned PCR primers designed from the highly conserved amino acid sequences of GyrB were effective in many but not all bacterial species for the PCR amplification of *gyrB*. From DNA of some bacterial species, no PCR amplification was observed using these primers.

15 [0010] Besides, there was another problem associated with these primers. The genes for type IV topoisomerase (*parE*) were also amplified from DNA of some bacterial species by using these primers. Topoisomerase IV (*ParE*) is a bacterial enzyme that appears to be closely related to DNA gyrase. This enzyme involves in the partition of chromosomes into daughter cells. If a *parE* gene but not *gyrB* gene is amplified from a DNA, and if a phylogenetic analysis is carried out without recognizing that the amplified sequence is *parE* but not *gyrB*, it will bring some confusion to the phylogenetic analysis. To avoid such problem associated with the amplification of paralogous genes, primers which do not amplify *parE* should be developed.

20 [0011] It is an object of the present invention to solve the above-described problems of the primers and to provide a means which enables the identification/classification and detection/monitoring of a wide range of organisms using *gyrB* sequences.

25 [0012] Comparing the amino acid sequence data of GyrB collected by the inventors with those of *ParE*, the inventors have found a plurality of the amino acid sequences of GyrB which are appropriate for designing PCR primers capable of specifically amplifying *gyrB* genes. By using the newly designed PCR primers in combination of the primers mentioned in the section of BACKGROUND OF THE INVENTION, it became possible to determine *gyrB* sequences more easily and precisely from a wider range of organisms. The present invention has been achieved based on the above-described findings.

30 [0013] The present invention relates to a method for the identification and detection of organisms using nucleotide sequences amplified by using two primers, at least one of the primers being an oligonucleotide which codes for all or a part of one of the following amino acid sequences (a) through (l),

(a) (Pro or Ser)-(Ala or Thr)-(Ala, Val or Leu)-(Glu or Asp)-(Val or Thr)-(Ile or Val)-(Met, Leu or Phe)-Thr-(Val, Gln or Ile)-Leu-His-Ala-Gly-Gly-Lys-Phe-(Asp or Gly)-(Asp, Gly, Asn or Ser)-(Ser, Lys, Gly, Asp or Asn)

(b) Gly-Gly-Thr-His

40 (c) (Ile or Leu)-Met-Thr-Asp-Ala-Asp-Val-Asp-Gly-(Ala or Ser)-His-Ile-Arg-Thr-Leu

(d) Arg-Lys-Arg-Pro-(Gly or Ala)-Met-Tyr-Ile-Gly-(Ser or Asp)-Thr

(e) Gln-(Thr or Pro)-(Lys or Asn)-(Thr, Asp, Gly, Lys, Ser, Phe or Tyr)-Lys-Leu

(f) (Tyr or Phe)-Lys-Gly-Leu-Gly-Glu-Met-Asn-(Ala or Pro)

(g) Val-Glu-Gly-Asp-Ser-Ala-Gly-Gly-Ser

45 (h) Lys-(His or Val)-Pro-Asp-Pro-(Gln or Lys)-Phe

(i) Leu-Pro-Gly-Lys-Leu-Ala-Asp-Cys-(Ser or Gln)-(Ser or Glu)-(Lys or Arg)-Asp-Pro-(Ala or Ser)

(j) Gln-Leu-(Trp or Arg)-(Glu or Asp)-Thr-Thr-(Met or Leu)-(Asp or Asn)-Pro

(k) Ala-(Lys or Arg)-(Lys or Arg)-Ala-Arg-Glu

50 (l) Phe-Thr-Asn-Asn-Ile-(Pro or Asn)-(Thr or Gln)

and which functions as a substantial primer. The primer which functions as a substantial primer used herein means an oligonucleotide having such a length that allows specific hybridization to a specific site in a template DNA.

[0014] The following drawing illustrates the invention:

55 Fig. 1 shows the locational relationship between the amino acid sequence (a) through (l) and the amino acid sequences of GyrB of several organisms.

[0015] Hereinbelow, the present invention will be described in detail.

[0016] In the present invention, a part of the *gyrB* of an organism of interest is amplified specifically by PCR, and then the nucleotide sequence of the amplified sequences are determined for the taxonomic characterization of the organism.

[0017] As a PCR primer, an oligonucleotide may be used which codes for all or a part of one of the following amino acid sequences (a) through (l):

5 and which functions as a substantial primer. The relationship between the above amino acid sequences (a) through (l) and the amino acid sequences of GyrB from *Bacillus subtilis* 168 strain, *Escherichia coli* K-12 strain and *Pseudomonas putida* PRS200 strain are shown in Fig. 1.

[0018] Most of the amino acid sequences listed (a) through (l) are degenerate, and numerous oligonucleotide sequences can be designed from the listed amino acid sequences. The following amino sequences can be enumerated as examples of amino acid sequences to be used for the design of oligonucleotide primers while the following nucleotide sequences can be enumerated as examples of specific primers.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (a):

15 The amino acid sequence shown in SEQ ID NO: 26, 30, 54, 55, 56 and 57 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 25, 29 and 53 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (b):

20 The amino acid sequence shown in SEQ ID NO: 34, 36 and 37 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 33 and 35 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (c):

25 The amino acid sequence shown in SEQ ID NO: 28, 32 and 42 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 27, 31 and 41 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (d):

30 The amino acid sequence shown in SEQ ID NO: 46 and 47 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 45 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (e):

35 The amino acid sequence shown in SEQ ID NO: 39 and 40 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 38 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (f):

40 The amino acid sequence shown in SEQ ID NO: 44 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 43 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (g):

45 The amino acid sequence shown in SEQ ID NO: 49 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 48 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (h):

50 The amino acid sequence shown in SEQ ID NO: 63 and 64 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 62 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (i):

55 The amino acid sequence shown in SEQ ID NO: 59 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 58 can be given as the sequences of primers for the specific amplification of *gyrB*.

Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (j):

# EP 0 935 003 A2

The amino acid sequence shown in SEQ ID NO: 66, 67 and 68 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 65 can be given as the sequences of primers for the specific amplification of *gyrB*.

5 Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (k):

The amino acid sequence shown in SEQ ID NO: 51 and 52 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 50 can be given as the sequences of primers for the specific amplification of *gyrB*.

10 Amino Acid and Oligonucleotides Sequences Corresponding to the Amino Acid Sequence (l):

The amino acid sequence shown in SEQ ID NO: 61 can be given as the amino acid sequences to be used for the design of oligonucleotide primers.

The nucleotide sequences shown in SEQ ID NO: 60 can be given as the sequences of primers for the specific amplification of *gyrB*.

15

[0019] Correspondence of each amino acid and oligonucleotide sequence are shown in Table 1.

Table 1

20

sequence	amino acid	oligonucleotide
a	SEQ ID NO. 26	SEQ ID NO. 25
	SEQ ID NO. 30	SEQ ID NO. 29
	SEQ ID NO. 54,55,56,57	SEQ ID NO. 53
b	SEQ ID NO. 34	SEQ ID NO. 33
	SEQ ID NO. 36,37	SEQ ID NO. 35
c	SEQ ID NO. 28	SEQ ID NO. 27
	SEQ ID NO. 32	SEQ ID NO. 31
	SEQ ID NO. 42	SEQ ID NO. 41
d	SEQ ID NO. 46,47	SEQ ID NO. 45
e	SEQ ID NO. 39,40	SEQ ID NO. 38
f	SEQ ID NO. 44	SEQ ID NO. 43
g	SEQ ID NO. 49	SEQ ID NO. 48
h	SEQ ID NO. 63,64	SEQ ID NO. 62
i	SEQ ID NO. 59	SEQ ID NO. 58
j	SEQ ID NO. 66,67,68	SEQ ID NO. 65
k	SEQ ID NO. 51,52	SEQ ID NO. 50
l	SEQ ID NO. 61	SEQ ID NO. 60

45

[0020] The amino acid sequences listed (a) through (l) are not necessarily conserved in all *GyrB*. Therefore, primers allowing the amplification of *gyrB* should be selected appropriately.

50 [0021] It is possible to directly determine the nucleotide sequence of the amplified PCR product without subcloning by using primers complementary to either the 5-end or the 3-end of the product.

Examples:

55 EXAMPLE 1

[0022] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 25 and 27 (corresponding to the amino acid sequences of SEQ ID NOS: 26 and 28, respectively) as primers and

## EP 0 935 003 A2

DNA from *Bacteroides vulgatus* IFO 14291 strain as a template. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 1 and 2, respectively. The PCR amplification conditions were as described below.

PCR amplification conditions:	
96 °C 1 min; 48°C 1 min; 72°C 2 min:	3 cycles
96 °C 1 min; 48°C 1 min; 72°C 2 min:	3 cycles
96 °C 1 min; 48°C 1 min; 72°C 2 min:	30 cycles
Total:	36 cycles

Primer concentration 1  $\mu$  M each  
dATP 200  $\mu$  M each  
Template DNA < 1  $\mu$  g/100  $\mu$  l

[0023] AmpliTaq™ and the supplied PCR Buffer (Perkin Elmer) were used.

### EXAMPLE 2

[0024] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 29 and 31 (corresponding to the amino acid sequences of SEQ ID NOS: 30 and 32, respectively) as primers and DNA from *Mycobacterium simiae* KPM 1403 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 3 and 4, respectively.

### EXAMPLE 3

[0025] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 33 and 27 (corresponding to the amino acid sequences of SEQ ID NOS: 34 and 28, respectively) as primers and DNA from *Chitinophaga pinensis* DSM 2588 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 5 and 6, respectively.

### EXAMPLE 4

[0026] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 25 and 35 (corresponding to the amino acid sequences of SEQ ID NO: 26 and SEQ ID NO: 36 or 37, respectively) as primers and DNA from *Flavobacterium aquatile* IAM 12316 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 7 and 8, respectively.

### EXAMPLE 5

[0027] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 29 and 38 (corresponding to the amino acid sequences of SEQ ID NO: 30 and SEQ ID NO: 39 or 40, respectively) as primers and DNA from *Mycobacterium asiaticum* ATCC 25274 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 9 and 10, respectively.

### EXAMPLE 6

[0028] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID

EP 0 935 003 A2

NOS: 41 and 43 (corresponding to the amino acid sequences of SEQ ID NOS: 42 and 44, respectively) as primers and DNA from *Cytophaga lytica* IFO 16020 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 11 and 12, respectively.

EXAMPLE 7

[0029] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 45 and 48 (corresponding to the amino acid sequences of SEQ ID NO: 46 or 47 and SEQ ID NO: 49, respectively) as primers and DNA from *Synechococcus* sp. PCC 6301 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 13 and 14, respectively.

EXAMPLE 8

[0030] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 53 and 62 (corresponding to the amino acid sequences of SEQ ID NO: 54, 55, 56 or 57 and SEQ ID NO: 63 or 64, respectively) as primers and DNA from *Caulobacter crescentus* ATCC 15252 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 15 and 16, respectively.

EXAMPLE 9

[0031] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 53 and 58 (corresponding to the amino acid sequences of SEQ ID NO: 54, 55, 56 or 57 and SEQ ID NO: 59, respectively) as primers and DNA from *Pseudomonas putida* ATCC 17484 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 17 and 18, respectively.

EXAMPLE 10

[0032] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 65 and 50 (corresponding to the amino acid sequences of SEQ ID NO: 66, 67 or 68 and SEQ ID NO: 51 or 52, respectively) as primers and DNA from *Synechococcus* sp. PCC 6301 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 19 and 20, respectively.

EXAMPLE 11

[0033] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 60 and 31 (corresponding to the amino acid sequences of SEQ ID NOS: 61 and 32, respectively) as primers and DNA from *Caulobacter crescentus* ATCC 15252 strain as a template. The PCR amplification conditions were the same as in Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 21 and 22, respectively.

EXAMPLE 12

[0034] A PCR was performed using oligonucleotides represented by the nucleotide sequences shown in SEQ ID NOS: 25 and 43 (corresponding to the amino acid sequences of SEQ ID NOS: 26 and 44, respectively) as primers and DNA from an unidentified strain MBIC 1544 as a template. The PCR amplification conditions were the same as Example 1. The nucleotide sequence of the amplified DNA fragment and the amino acid sequence deduced therefrom are shown in SEQ ID NOS: 23 and 24, respectively.

[0035] This nucleotide sequence was compared with the nucleotide sequence database possessed by the applicant. As a result, the unidentified strain MBIC 1544 was identified as *Cytophaga lytica*.

[0036] With the nucleotide sequence of *gyrB* determined by the present invention, it is possible to classify or identify an unidentified microorganism strain quickly and accurately. Besides, according to the present invention, PCR primers for monitoring a specific microorganism which are needed in risk assessment in various bioprocesses can be designed easily. Also, the present invention enables highly accurate monitoring of changes in mycelial tufts.

EP 0 935 003 A2

[0037] The invention thus allows the determination of the presence or amount of a microorganism in a sample. The invention may be applicable in medical and industrial contexts. For example, in a medical context a sample can be tested for the presence of a microorganism, which may be useful in assessing infection. Therefore, the sample could be serum, blood plasma, or a swab from the eye, ear, mouth, throat, urethra, cervix, vagina, penis or rectum. Alternatively the sample could be a sweep from a culture of bacteria grown on solid or in a liquid media.

[0038] In an industrial context, a sample could be tested to determine the amount of a microorganism in a fermentation process. Alternatively a sample could be tested to assess contamination of fermentation broths by unwanted microorganisms. Thus, the sample can be a sample from any bioprocess or fermentation process, where the amount of or presence of a microorganism needs to be ascertained.



EP 0 935 003 A2

SEQUENCE LISTING

5 SEQ ID NO: 1  
 SEQUENCE LENGTH: 1212  
 SEQUENCE TYPE: nucleic acid  
 10 STRANDEDNESS: double  
 TOPOLOGY: linear  
 15 MOLECULE TYPE: genomic DNA  
 ORIGINAL SOURCE  
 ORGANISM: *Bacteroides vulgatus*  
 20 STRAIN: IFO 14291  
 SEQUENCE DESCRIPTION  
 GAC AAA GGT TCT TAC AAG GTT TCA GGC GGT CTG CAC GGT GTA GGT GTT 48  
 25 Asp Lys Gly Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val  
 1 5 10 15  
 TCT TGT GTG AAC GCC TTG TCT ACT CAC ATG ACC ACA CAG GTA TTC CGC 96  
 30 Ser Cys Val Asn Ala Leu Ser Thr His Met Thr Thr Gln Val Phe Arg  
 20 25 30  
 GGT GGC AAG ATC TAC CAG CAG GAA TAC AGC TGC GGA CAT CCT TTG TAT 144  
 35 Gly Gly Lys Ile Tyr Gln Gln Glu Tyr Ser Cys Gly His Pro Leu Tyr  
 35 40 45  
 TCT GTA AAA GAA GTA GGA ACA GCT GAT ATT ACC GGA ACA AAA CAG ACT 192  
 40 Ser Val Lys Glu Val Gly Thr Ala Asp Ile Thr Gly Thr Lys Gln Thr  
 50 55 60  
 TTC TGG CCG GAT GAT ACC ATC TTC ACT GTT ACC GAA TAT AAG TTT GAC 240  
 45 Phe Trp Pro Asp Asp Thr Ile Phe Thr Val Thr Glu Tyr Lys Phe Asp  
 65 70 75 80  
 50 ATT CTA CAG GCA CGT ATG CGT GAA TTG GCC TAC TTG AAC AAA GGT ATC 288  
 Ile Leu Gln Ala Arg Met Arg Glu Leu Ala Tyr Leu Asn Lys Gly Ile  
 55

EP 0 935 003 A2

	85	90	95	
5	ACC ATT TCA CTG ACC GAC CGC CGG ATC AAA GAA GAA GAT GGC AGC TTC	336		
	Thr Ile Ser Leu Thr Asp Arg Arg Ile Lys Glu Glu Asp Gly Ser Phe			
	100	105	110	
10	AAG AAA GAA ATA TTC CAT TCG GAC GAA GGA GTG AAA GAG TTT GTA CGT	384		
	Lys Lys Glu Ile Phe His Ser Asp Glu Gly Val Lys Glu Phe Val Arg			
	115	120	125	
15	TTC CTG AAC CGT AAC AAC GAA GCG CTG ATT AAT GAT GTC ATT TAT CTG	432		
	Phe Leu Asn Arg Asn Asn Glu Ala Leu Ile Asn Asp Val Ile Tyr Leu			
	130	135	140	
20				
	AAT ACC GAA AAA AAC AAT ACC CCC ATT GAA TGT GCC ATC ATG TAC AAT	480		
	Asn Thr Glu Lys Asn Asn Thr Pro Ile Glu Cys Ala Ile Met Tyr Asn			
25	145	150	155	160
	ACA GGC TAT CGT GAA AGC CTG CAT TCG TAT GTA AAC AAT ATC AAT ACA	528		
	Thr Gly Tyr Arg Glu Ser Leu His Ser Tyr Val Asn Asn Ile Asn Thr			
30		165	170	175
	ATA GAA GGC GGT ACA CAC GAG GCC GGT TTC CGC AGC GCA TTA ACC CGT	576		
	Ile Glu Gly Gly Thr His Glu Ala Gly Phe Arg Ser Ala Leu Thr Arg			
35		180	185	190
	GTA CTG AAG AAA TAT GCG GAA GAT ACC AAA GCA CTG GAA AAA GCA AAA	624		
40	Val Leu Lys Lys Tyr Ala Glu Asp Thr Lys Ala Leu Glu Lys Ala Lys			
	195	200	205	
	GTC GAG ATT TCG GGA GAG GAC TTC CGC GAA GGC TTG ATT GCC GTC ATT	672		
45	Val Glu Ile Ser Gly Glu Asp Phe Arg Glu Gly Leu Ile Ala Val Ile			
	210	215	220	
	TCA GTG AAA GTA GCC GAG CCG CAG TTC GAA GGA CAG ACC AAG ACC AAG	720		
50	Ser Val Lys Val Ala Glu Pro Gln Phe Glu Gly Gln Thr Lys Thr Lys			
	225	230	235	240

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EP 0 935 003 A2

5 CTG GGC AAC AGC GAA GTG AGT GGT GCC GTG AAC CAA GCT GTA GGC GAA 768  
 Leu Gly Asn Ser Glu Val Ser Gly Ala Val Asn Gln Ala Val Gly Glu  
 245 250 255  
 10 GCG CTT ACA TAT TAT CTG GAA GAA CAT CCG AAA GAA GCA AAA CAG ATT 816  
 Ala Leu Thr Tyr Tyr Leu Glu Glu His Pro Lys Glu Ala Lys Gln Ile  
 260 265 270  
 15 GTT GAC AAA GTG ATC CTG GCT GCA ACA GCG CGT ATC GCC GCA CGC AAG 864  
 Val Asp Lys Val Ile Leu Ala Ala Thr Ala Arg Ile Ala Ala Arg Lys  
 275 280 285  
 20 GCA CGT GAA TCT GTT CAA AGA AAG AGT CCG ATG GGC GGT GGC GGA CTG 912  
 Ala Arg Glu Ser Val Gln Arg Lys Ser Pro Met Gly Gly Gly Gly Leu  
 290 295 300  
 25 CCG GGC AAA CTG GCC GAC TGC TCG AGC CGT AAT CCG GAG GAA TGT GAA 960  
 Pro Gly Lys Leu Ala Asp Cys Ser Ser Arg Asn Pro Glu Glu Cys Glu  
 305 310 315 320  
 30 CTA TTC CTG GTC GAG GGT GAC TCG GCA GGT GGT TCT GCC AAG CAA GGA 1008  
 Leu Phe Leu Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Gly  
 325 330 335  
 35 CGT AGC CGT GCC TTC CAG GCA ATT CTA CCT TTG AGG GGT AAA ATC CTG 1056  
 Arg Ser Arg Ala Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu  
 340 345 350  
 40 AAT GTG GAA AAA GCG ATG TGG CAC AAG GCT TTT GAA AGC GAT GAG GTC 1104  
 Asn Val Glu Lys Ala Met Trp His Lys Ala Phe Glu Ser Asp Glu Val  
 355 360 365  
 45 AAT AAT ATC ATC ACC GCC CTG GGT GTC CGT TTC GGT GTG GAC GGA AAT 1152  
 Asn Asn Ile Ile Thr Ala Leu Gly Val Arg Phe Gly Val Asp Gly Asn  
 370 375 380  
 50 GAT GAC AGC AAA AAA GCG AAC ATC GAC AAG CTG CGT TAT CAC AAA GTG 1200  
 Asp Asp Ser Lys Lys Ala Asn Ile Asp Lys Leu Arg Tyr His Lys Val  
 55

EP 0 935 003 A2

385 390 395 400

GTG ATC ATG ACC

Val Ile Met Thr

SEQ ID NO: 2

SEQUENCE LENGTH: 404

SEQUENCE TYPE: amino acid

TOPOLOGY: unknown

MOLECULE TYPE: protein

ORIGINAL SOURCE

ORGANISM: *Bacteroides vulgatus*

STRAIN: IFO 14291

SEQUENCE DESCRIPTION

Asp Lys Gly Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val

1 5 10 15

Ser Cys Val Asn Ala Leu Ser Thr His Met Thr Thr Gln Val Phe Arg

20 25 30

Gly Gly Lys Ile Tyr Gln Gln Glu Tyr Ser Cys Gly His Pro Leu Tyr

35 40 45

Ser Val Lys Glu Val Gly Thr Ala Asp Ile Thr Gly Thr Lys Gln Thr

50 55 60

Phe Trp Pro Asp Asp Thr Ile Phe Thr Val Thr Glu Tyr Lys Phe Asp

65 70 75 80

Ile Leu Gln Ala Arg Met Arg Glu Leu Ala Tyr Leu Asn Lys Gly Ile

85 90 95

Thr Ile Ser Leu Thr Asp Arg Arg Ile Lys Glu Glu Asp Gly Ser Phe

100 105 110

Lys Lys Glu Ile Phe His Ser Asp Glu Gly Val Lys Glu Phe Val Arg

115 120 125

EP 0 935 003 A2

Phe Leu Asn Arg Asn Asn Glu Ala Leu Ile Asn Asp Val Ile Tyr Leu  
130 135 140  
5 Asn Thr Glu Lys Asn Asn Thr Pro Ile Glu Cys Ala Ile Met Tyr Asn  
145 150 155 160  
10 Thr Gly Tyr Arg Glu Ser Leu His Ser Tyr Val Asn Asn Ile Asn Thr  
165 170 175  
Ile Glu Gly Gly Thr His Glu Ala Gly Phe Arg Ser Ala Leu Thr Arg  
15 180 185 190  
Val Leu Lys Lys Tyr Ala Glu Asp Thr Lys Ala Leu Glu Lys Ala Lys  
195 200 205  
20 Val Glu Ile Ser Gly Glu Asp Phe Arg Glu Gly Leu Ile Ala Val Ile  
210 215 220  
Ser Val Lys Val Ala Glu Pro Gln Phe Glu Gly Gln Thr Lys Thr Lys  
25 225 230 235 240  
Leu Gly Asn Ser Glu Val Ser Gly Ala Val Asn Gln Ala Val Gly Glu  
245 250 255  
30 Ala Leu Thr Tyr Tyr Leu Glu Glu His Pro Lys Glu Ala Lys Gln Ile  
260 265 270  
Val Asp Lys Val Ile Leu Ala Ala Thr Ala Arg Ile Ala Ala Arg Lys  
35 275 280 285  
Ala Arg Glu Ser Val Gln Arg Lys Ser Pro Met Gly Gly Gly Gly Leu  
40 290 295 300  
Pro Gly Lys Leu Ala Asp Cys Ser Ser Arg Asn Pro Glu Glu Cys Glu  
305 310 315 320  
45 Leu Phe Leu Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Gly  
325 330 335  
Arg Ser Arg Ala Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu  
50 340 345 350  
Asn Val Glu Lys Ala Met Trp His Lys Ala Phe Glu Ser Asp Glu Val

55

EP 0 935 003 A2

355 360 365  
 5 Asn Asn Ile Ile Thr Ala Leu Gly Val Arg Phe Gly Val Asp Gly Asn  
 370 375 380  
 Asp Asp Ser Lys Lys Ala Asn Ile Asp Lys Leu Arg Tyr His Lys Val  
 10 385 390 395 400  
 Val Ile Met Thr  
  
 15 SEQ ID NO: 3  
 SEQUENCE LENGTH: 1263  
 SEQUENCE TYPE: nucleic acid  
 20 STRANDEDNESS: double  
 TOPOLOGY: linear  
 MOLECULE TYPE: genomic DNA  
 25 ORIGINAL SOURCE  
 ORGANISM: *Mycobacterium simiae*  
 STRAIN: KPM 1403  
 30 SEQUENCE DESCRIPTION  
 GGG GAG AAC AGT GGC TAC ACC GTC AGC GGC GGG TTG CAC GGG GTC GGA 48  
 35 Gly Glu Asn Ser Gly Tyr Thr Val Ser Gly Gly Leu His Gly Val Gly  
 1 5 10 15  
 GTG TCG GTG GTC AAC GCC CTG TCC ACC CGC CTG GAA GTC AAC GTC AAG 96  
 40 Val Ser Val Val Asn Ala Leu Ser Thr Arg Leu Glu Val Asn Val Lys  
 20 25 30  
 CGT GAC GGC TAT GAG TGG TTC CAG TAC TAC GAC CGG GCG GTG CCC GGC 144  
 45 Arg Asp Gly Tyr Glu Trp Phe Gln Tyr Tyr Asp Arg Ala Val Pro Gly  
 35 40 45  
 ACC CTC AAG CAA GGC GAG GCG ACC AAG AAG ACC GGC ACC ACG ATC CGG 192  
 50 Thr Leu Lys Gln Gly Glu Ala Thr Lys Lys Thr Gly Thr Thr Ile Arg  
 50 55 60

EP 0 935 003 A2

	TTC TGG GCC GAT CCT GAG ATC TTC GAA ACC ACC CAG TAC GAC TTC GAG	240
5	Phe Trp Ala Asp Pro Glu Ile Phe Glu Thr Thr Gln Tyr Asp Phe Glu	
	65                                      70                                      75                                      80	
	ACG GTG GCG CGC CGG TTG CAG GAA ATG GCG TTC CTC AAC AAG GGC CTG	288
10	Thr Val Ala Arg Arg Leu Gln Glu Met Ala Phe Leu Asn Lys Gly Leu	
	85                                      90                                      95	
	ACC ATC AAC CTC ACC GAC GAA CGT GTC GAG CAG GAC GAG GTG GTC GAT	336
15	Thr Ile Asn Leu Thr Asp Glu Arg Val Glu Gln Asp Glu Val Val Asp	
	100                                      105                                      110	
	GAG GTG GTT AGC GAC ACC GCC GAG GCG CCG AAG TCA GCC GAG GAG CAG	384
20	Glu Val Val Ser Asp Thr Ala Glu Ala Pro Lys Ser Ala Glu Glu Gln	
	115                                      120                                      125	
	GCG GCC GAA TCG GCC AAG CCG CAC AAG GTC AAG CAC CGC ACG TTC CAC	432
25	Ala Ala Glu Ser Ala Lys Pro His Lys Val Lys His Arg Thr Phe His	
	130                                      135                                      140	
	TAC CCG GGT GGG TTG GTG GAT TTC GTC AAG CAC ATC AAT CGC ACC AAA	480
30	Tyr Pro Gly Gly Leu Val Asp Phe Val Lys His Ile Asn Arg Thr Lys	
	145                                      150                                      155                                      160	
	AAC CCG ATC CAG CAG AGC GTC ATC GAC TTC GAC GGC AAA GGA ACC GGG	528
35	Asn Pro Ile Gln Gln Ser Val Ile Asp Phe Asp Gly Lys Gly Thr Gly	
	165                                      170                                      175	
	CAC GAA GTC GAG ATC GCG ATG CAG TGG AAC GGT GGT TAT TCG GAG TCG	576
40	His Glu Val Glu Ile Ala Met Gln Trp Asn Gly Gly Tyr Ser Glu Ser	
	180                                      185                                      190	
	GTG CAC ACC TTC GCC AAC ACC ATC AAC ACC CAT GAG GGC GGC ACC CAC	624
45	Val His Thr Phe Ala Asn Thr Ile Asn Thr His Glu Gly Gly Thr His	
	195                                      200                                      205	
	GAG GAG GGC TTC CGC AGC GCG CTG ACC TCG GTG GTG AAC AAG TAC GCC	672
50	Glu Glu Gly Phe Arg Ser Ala Leu Thr Ser Val Val Asn Lys Tyr Ala	
55		

EP 0 935 003 A2

	210	215	220	
5	AAA GAC AAG AAG CTG CTC AAG GAC AAG GAT CCC AAC CTC ACC GGC GAC			720
	Lys Asp Lys Lys Leu Leu Lys Asp Lys Asp Pro Asn Leu Thr Gly Asp			
	225	230	235	240
10	GAC ATC CGA GAA GGG CTG GCC GCG GTG ATC TCC GTG AAG GTC GCC GAG			768
	Asp Ile Arg Glu Gly Leu Ala Ala Val Ile Ser Val Lys Val Ala Glu			
		245	250	255
15	CCG CAG TTC GAG GGC CAG ACT AAG ACG AAA CTC GGC AAC ACC GAG GTC			816
	Pro Gln Phe Glu Gly Gln Thr Lys Thr Lys Leu Gly Asn Thr Glu Val			
		260	265	270
20	AAG TCG TTT GTC CAG AAA GTC TGT AAC GAA CAA CTC ACT CAC TGG TTC			864
	Lys Ser Phe Val Gln Lys Val Cys Asn Glu Gln Leu Thr His Trp Phe			
		275	280	285
25	GAG GCG AAC CCG TCG GAA GCT AAA ACC GTT GTA AAC AAG GCG GTT TCG			912
	Glu Ala Asn Pro Ser Glu Ala Lys Thr Val Val Asn Lys Ala Val Ser			
		290	295	300
30	TCG GCC CAG GCC CGC ATT GCG GCG CGT AAG GCG CGG GAG TTG GTG CGG			960
	Ser Ala Gln Ala Arg Ile Ala Ala Arg Lys Ala Arg Glu Leu Val Arg			
	305	310	315	320
35	CGT AAG AGT GCT ACG GAT TTG GGT GGG TTG CCG GGC AAG TTG GCT GAT			1008
	Arg Lys Ser Ala Thr Asp Leu Gly Gly Leu Pro Gly Lys Leu Ala Asp			
		325	330	335
40	TGC CGC TCG ACG GAT CCG CGG AAG TCT GAG CTG TAT GTG GTG GAA GGT			1056
	Cys Arg Ser Thr Asp Pro Arg Lys Ser Glu Leu Tyr Val Val Glu Gly			
		340	345	350
45	GAT TCC GCG GGT GGG TCG GCG AAA AGT GGG CGT GAT TCG ATG TTC CAG			1104
	Asp Ser Ala Gly Gly Ser Ala Lys Ser Gly Arg Asp Ser Met Phe Gln			
50		355	360	365
	GCG ATC TTG CCG CTG CGC GGC AAG ATC ATC AAC GTC GAA AAG GCC CGC			1152
55				



EP 0 935 003 A2

Ala Ile Leu Pro Leu Arg Gly Lys Ile Ile Asn Val Glu Lys Ala Arg  
 370 375 380  
 5 ATC GAT CGG GTG CTG AAA AAC ACC GAA GTC CAG GCC ATC ATC ACC GCG 1200  
 Ile Asp Arg Val Leu Lys Asn Thr Glu Val Gln Ala Ile Ile Thr Ala  
 385 390 395 400  
 10 CTG GGC ACC GGC ATC CAC GAC GAA TTC GAC ATC ACC AAA CTG CGT TAC 1248  
 Leu Gly Thr Gly Ile His Asp Glu Phe Asp Ile Thr Lys Leu Arg Tyr  
 405 410 415  
 15 CAC AAG ATC GTG TTG 1263  
 His Lys Ile Val Leu  
 20 420

SEQ ID NO: 4

25 SEQUENCE LENGTH: 421

SEQUENCE TYPE: amino acid

TOPOLOGY: unknown

30 MOLECULE TYPE: protein

ORIGINAL SOURCE

35 ORGANISM: *Mycobacterium siniae*

STRAIN: KPM 1403

SEQUENCE DESCRIPTION

40 Gly Glu Asn Ser Gly Tyr Thr Val Ser Gly Gly Leu His Gly Val Gly  
 1 5 10 15  
 Val Ser Val Val Asn Ala Leu Ser Thr Arg Leu Glu Val Asn Val Lys  
 45 20 25 30  
 Arg Asp Gly Tyr Glu Trp Phe Gln Tyr Tyr Asp Arg Ala Val Pro Gly  
 35 40 45  
 50 Thr Leu Lys Gln Gly Glu Ala Thr Lys Lys Thr Gly Thr Thr Ile Arg  
 50 55 60

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EP 0 935 003 A2

Phe Trp Ala Asp Pro Glu Ile Phe Glu Thr Thr Gln Tyr Asp Phe Glu  
 65 70 75 80  
 5 Thr Val Ala Arg Arg Leu Gln Glu Met Ala Phe Leu Asn Lys Gly Leu  
 85 90 95  
 10 Thr Ile Asn Leu Thr Asp Glu Arg Val Glu Gln Asp Glu Val Val Asp  
 100 105 110  
 Glu Val Val Ser Asp Thr Ala Glu Ala Pro Lys Ser Ala Glu Glu Gln  
 115 120 125  
 15 Ala Ala Glu Ser Ala Lys Pro His Lys Val Lys His Arg Thr Phe His  
 130 135 140  
 20 Tyr Pro Gly Gly Leu Val Asp Phe Val Lys His Ile Asn Arg Thr Lys  
 145 150 155 160  
 Asn Pro Ile Gln Gln Ser Val Ile Asp Phe Asp Gly Lys Gly Thr Gly  
 165 170 175  
 25 His Glu Val Glu Ile Ala Met Gln Trp Asn Gly Gly Tyr Ser Glu Ser  
 180 185 190  
 30 Val His Thr Phe Ala Asn Thr Ile Asn Thr His Glu Gly Gly Thr His  
 195 200 205  
 35 Glu Glu Gly Phe Arg Ser Ala Leu Thr Ser Val Val Asn Lys Tyr Ala  
 210 215 220  
 Lys Asp Lys Lys Leu Leu Lys Asp Lys Asp Pro Asn Leu Thr Gly Asp  
 225 230 235 240  
 40 Asp Ile Arg Glu Gly Leu Ala Ala Val Ile Ser Val Lys Val Ala Glu  
 245 250 255  
 45 Pro Gln Phe Glu Gly Gln Thr Lys Thr Lys Leu Gly Asn Thr Glu Val  
 260 265 270  
 Lys Ser Phe Val Gln Lys Val Cys Asn Glu Gln Leu Thr His Trp Phe  
 275 280 285  
 50 Glu Ala Asn Pro Ser Glu Ala Lys Thr Val Val Asn Lys Ala Val Ser  
 55

EP 0 935 003 A2

	290	295	300													
	Ser	Ala	Gln	Ala	Arg	Ile	Ala	Ala	Arg	Lys	Ala	Arg	Glu	Leu	Val	Arg
5	305		310		315		320									
	Arg	Lys	Ser	Ala	Thr	Asp	Leu	Gly	Gly	Leu	Pro	Gly	Lys	Leu	Ala	Asp
			325				330						335			
10	Cys	Arg	Ser	Thr	Asp	Pro	Arg	Lys	Ser	Glu	Leu	Tyr	Val	Val	Glu	Gly
			340				345						350			
15	Asp	Ser	Ala	Gly	Gly	Ser	Ala	Lys	Ser	Gly	Arg	Asp	Ser	Met	Phe	Gln
			355				360						365			
	Ala	Ile	Leu	Pro	Leu	Arg	Gly	Lys	Ile	Ile	Asn	Val	Glu	Lys	Ala	Arg
20	370				375				380							
	Ile	Asp	Arg	Val	Leu	Lys	Asn	Thr	Glu	Val	Gln	Ala	Ile	Ile	Thr	Ala
	385				390				395				400			
25	Leu	Gly	Thr	Gly	Ile	His	Asp	Glu	Phe	Asp	Ile	Thr	Lys	Leu	Arg	Tyr
			405				410						415			
	His	Lys	Ile	Val	Leu											
30			420													

35 SEQ ID NO: 5

SEQUENCE LENGTH: 660

SEQUENCE TYPE: nucleic acid

40 STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

45 ORIGINAL SOURCE

ORGANISM: *Chitinophaga pinensis*

STRAIN: DSM 2588

50 SEQUENCE DESCRIPTION

GTA GCA GGC TTC CGC CGT GCG ATA ACC CGT ATC TTC AAG AGC TAT GGT 48

55

EP 0 935 003 A2

	Val	Ala	Gly	Phe	Arg	Arg	Ala	Ile	Thr	Arg	Ile	Phe	Lys	Ser	Tyr	Gly	
	1				5					10					15		
5	GAT	AAG	AAC	AAA	ATG	TTC	GAA	AAA	ACC	AAG	ATC	GAA	GTA	ACA	GGT	GAT	96
	Asp	Lys	Asn	Lys	Met	Phe	Glu	Lys	Thr	Lys	Ile	Glu	Val	Thr	Gly	Asp	
					20					25					30		
10	GAC	TTC	CGT	GAA	GGT	CTG	AGC	GCT	ATC	ATC	AGC	GTA	AAA	GTA	CCT	GAA	144
	Asp	Phe	Arg	Glu	Gly	Leu	Ser	Ala	Ile	Ile	Ser	Val	Lys	Val	Pro	Glu	
					35					40					45		
15	CCA	CAG	TTC	GAA	GGC	CAG	ACC	AAA	ACC	AAA	CTC	GGT	AAC	TCC	GAT	GTA	192
	Pro	Gln	Phe	Glu	Gly	Gln	Thr	Lys	Thr	Lys	Leu	Gly	Asn	Ser	Asp	Val	
					50					55					60		
20	ATG	GGG	GTT	GTG	GAC	AGT	TCC	GTA	GCA	GCC	GTA	CTG	GAT	GCC	TAC	CTG	240
	Met	Gly	Val	Val	Asp	Ser	Ser	Val	Ala	Ala	Val	Leu	Asp	Ala	Tyr	Leu	
25					65					70					75		80
	GAA	GAA	CAT	CCC	CGC	GAA	GCC	AAG	ATC	ATT	ATC	AAT	AAA	GTG	GTA	CTG	288
	Glu	Glu	His	Pro	Arg	Glu	Ala	Lys	Ile	Ile	Ile	Asn	Lys	Val	Val	Leu	
30										85					90		95
	GCA	GCA	CAG	GCG	CGT	GAA	GCA	GCC	CGT	AAA	GCA	CGC	CAG	ATG	GTA	CAG	336
35	Ala	Ala	Gln	Ala	Arg	Glu	Ala	Ala	Arg	Lys	Ala	Arg	Gln	Met	Val	Gln	
										100					105		110
	CGT	AAG	AGC	GTA	CTG	AGT	GGA	AGC	GGC	TTG	CCT	GGT	AAA	CTG	GCT	GAC	384
40	Arg	Lys	Ser	Val	Leu	Ser	Gly	Ser	Gly	Leu	Pro	Gly	Lys	Leu	Ala	Asp	
										115					120		125
45	TGC	TCT	GAA	AAT	GAT	CCT	GAA	AAA	TGT	GAA	CTG	TAC	CTG	GTA	GAG	GGT	432
	Cys	Ser	Glu	Asn	Asp	Pro	Glu	Lys	Cys	Glu	Leu	Tyr	Leu	Val	Glu	Gly	
										130					135		140
50	GAC	TCC	GCA	GGT	GGT	ACG	GCT	AAA	CAA	GGA	CGT	AAC	CGT	AGC	TTC	CAG	480
	Asp	Ser	Ala	Gly	Gly	Thr	Ala	Lys	Gln	Gly	Arg	Asn	Arg	Ser	Phe	Gln	
										145					150		155
55																	160

EP 0 935 003 A2

5 GCG ATC CTG CCG CTC AGG GGT AAA ATC CTG AAC GTG GAG AAA GCC ATG 528  
 Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu Asn Val Glu Lys Ala Met  
 165 170 175  
 10 GAG CAT AAG ATA TAT GAG AAT GAG GAG ATT AAA AAC ATC TTC ACC GCA 576  
 Glu His Lys Ile Tyr Glu Asn Glu Glu Ile Lys Asn Ile Phe Thr Ala  
 180 185 190  
 15 CTT GGT GTA ACC ATC GGT ACG GAA GAA GAT GAC AAA GCC CTC AAC CTC 624  
 Leu Gly Val Thr Ile Gly Thr Glu Glu Asp Asp Lys Ala Leu Asn Leu  
 195 200 205  
 20 TCC AAA CTG CGC TAT CAC AAA CTG ATC ATC ATG ACG 660  
 Ser Lys Leu Arg Tyr His Lys Leu Ile Ile Met Thr  
 210 215 220

25 SEQ ID NO: 6

SEQUENCE LENGTH: 220

SEQUENCE TYPE: amino acid

30 TOPOLOGY: unknown

MOLECULE TYPE: protein

ORIGINAL SOURCE

35 ORGANISM: *Chitinophaga pinensis*

STRAIN: DSM 2588

SEQUENCE DESCRIPTION

40 Val Ala Gly Phe Arg Arg Ala Ile Thr Arg Ile Phe Lys Ser Tyr Gly  
 1 5 10 15  
 45 Asp Lys Asn Lys Met Phe Glu Lys Thr Lys Ile Glu Val Thr Gly Asp  
 20 25 30  
 Asp Phe Arg Glu Gly Leu Ser Ala Ile Ile Ser Val Lys Val Pro Glu  
 35 40 45  
 50 Pro Gln Phe Glu Gly Gln Thr Lys Thr Lys Leu Gly Asn Ser Asp Val  
 55

EP 0 935 003 A2

	50	55	60
5	Met Gly Val Val Asp Ser Ser Val Ala Ala Val Leu Asp Ala Tyr Leu		
	65	70	75 80
	Glu Glu His Pro Arg Glu Ala Lys Ile Ile Ile Asn Lys Val Val Leu		
10	85	90	95
	Ala Ala Gln Ala Arg Glu Ala Ala Arg Lys Ala Arg Gln Met Val Gln		
	100	105	110
15	Arg Lys Ser Val Leu Ser Gly Ser Gly Leu Pro Gly Lys Leu Ala Asp		
	115	120	125
	Cys Ser Glu Asn Asp Pro Glu Lys Cys Glu Leu Tyr Leu Val Glu Gly		
20	130	135	140
	Asp Ser Ala Gly Gly Thr Ala Lys Gln Gly Arg Asn Arg Ser Phe Gln		
	145	150	155 160
25	Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu Asn Val Glu Lys Ala Met		
	165	170	175
30	Glu His Lys Ile Tyr Glu Asn Glu Glu Ile Lys Asn Ile Phe Thr Ala		
	180	185	190
	Leu Gly Val Thr Ile Gly Thr Glu Glu Asp Asp Lys Ala Leu Asn Leu		
35	195	200	205
	Ser Lys Leu Arg Tyr His Lys Leu Ile Ile Met Thr		
	210	215	220

SEQ ID NO: 7

SEQUENCE LENGTH: 537

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

ORIGINAL SOURCE

55

EP 0 935 003 A2

ORGANISM: *Flavobacterium aquatile*

STRAIN: IAM 12316

5

SEQUENCE DESCRIPTION

GAT AAA GAT TCT TAT AAA GTT TCG GGT GGA CTT CAC GGA GTT GGT GTT 48  
 Asp Lys Asp Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val  
 10 1 5 10 15  
 TCT TGC GTT AAT GCA CTT TCT GAT AAC CTA AAA GCA ACC GTT TTT AGA 96  
 15 Ser Cys Val Asn Ala Leu Ser Asp Asn Leu Lys Ala Thr Val Phe Arg  
 20 20 25 30  
 GAC GGA AAA GTG TAC GAG CAA GAA TAT GAA AAA GGT AAA GCA ATG TAT 144  
 20 Asp Gly Lys Val Tyr Glu Gln Glu Tyr Glu Lys Gly Lys Ala Met Tyr  
 35 40 45  
 CCG GTT AAG CAA GTT GGT GAA ACA ACA AAG CGA GGA ACA ATG GTT ACT 192  
 25 Pro Val Lys Gln Val Gly Glu Thr Thr Lys Arg Gly Thr Met Val Thr  
 50 55 60  
 TTT CAT CCT GAT AAA ACC ATT TTT ACT CAA ACA ATT GAG TAT TCT TAT 240  
 30 Phe His Pro Asp Lys Thr Ile Phe Thr Gln Thr Ile Glu Tyr Ser Tyr  
 65 70 75 80  
 GAT ACA CTT GCA GCA CGT ATG CGT GAA TTA TCT TTC CTG AAT AAA GGA 288  
 35 Asp Thr Leu Ala Ala Arg Met Arg Glu Leu Ser Phe Leu Asn Lys Gly  
 85 90 95  
 ATT ACA ATC ACA CTT ACA GAT AAA AGA CAT ACT AAA GAC AAC GGC GAT 336  
 40 Ile Thr Ile Thr Leu Thr Asp Lys Arg His Thr Lys Asp Asn Gly Asp  
 100 105 110  
 TTT GAA GGT GAA GTT TTT CAT TCT AAA GAA GGG CTT AAA GAA TTC GTT 384  
 45 Phe Glu Gly Glu Val Phe His Ser Lys Glu Gly Leu Lys Glu Phe Val  
 115 120 125  
 CGA TTT TTA GAT GCT GGT AGA GAA CCA ATT ATT TCT CAC GTA ATA AGC 432  
 50 Arg Phe Leu Asp Ala Gly Arg Glu Pro Ile Ile Ser His Val Ile Ser  
 55

EP 0 935 003 A2

130 135 140  
 5 ATG GAG CAC GAA AAA GGA GAA GTT CCT GTT GAG GTT GCT CTT GTT TAC 480  
 Met Glu His Glu Lys Gly Glu Val Pro Val Glu Val Ala Leu Val Tyr  
 145 150 155 160  
 10 AAT ACA AGT TAC TCC GAA AAT ATT TTC TCT TAC GTA AAT AAT ATT AAC 528  
 Asn Thr Ser Tyr Ser Glu Asn Ile Phe Ser Tyr Val Asn Asn Ile Asn  
 165 170 175  
 15 ACG CAC GAA 537  
 Thr His Glu

20 SEQ ID NO: 8  
 SEQUENCE LENGTH: 179  
 SEQUENCE TYPE: amino acid  
 25 TOPOLOGY: unknown  
 MOLECULE TYPE: protein  
 ORIGINAL SOURCE  
 30 ORGANISM: *Flavobacterium aquatile*  
 STRAIN: IAM 12316

35 SEQUENCE DESCRIPTION  
 Asp Lys Asp Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val  
 1 5 10 15  
 40 Ser Cys Val Asn Ala Leu Ser Asp Asn Leu Lys Ala Thr Val Phe Arg  
 20 25 30  
 Asp Gly Lys Val Tyr Glu Gln Glu Tyr Glu Lys Gly Lys Ala Met Tyr  
 45 35 40 45  
 Pro Val Lys Gln Val Gly Glu Thr Thr Lys Arg Gly Thr Met Val Thr  
 50 55 60  
 50 Phe His Pro Asp Lys Thr Ile Phe Thr Gln Thr Ile Glu Tyr Ser Tyr  
 65 70 75 80

55



EP 0 935 003 A2

Asp Thr Leu Ala Ala Arg Met Arg Glu Leu Ser Phe Leu Asn Lys Gly  
 85 90 95  
 5 Ile Thr Ile Thr Leu Thr Asp Lys Arg His Thr Lys Asp Asn Gly Asp  
 100 105 110  
 10 Phe Glu Gly Glu Val Phe His Ser Lys Glu Gly Leu Lys Glu Phe Val  
 115 120 125  
 Arg Phe Leu Asp Ala Gly Arg Glu Pro Ile Ile Ser His Val Ile Ser  
 130 135 140  
 15 Met Glu His Glu Lys Gly Glu Val Pro Val Glu Val Ala Leu Val Tyr  
 145 150 155 160  
 20 Asn Thr Ser Tyr Ser Glu Asn Ile Phe Ser Tyr Val Asn Asn Ile Asn  
 165 170 175  
 25 Thr His Glu

SEQ ID NO: 9

SEQUENCE LENGTH: 783

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

ORIGINAL SOURCE

ORGANISM: *Mycobacterium asiaticum*

STRAIN: ATCC 25274

SEQUENCE DESCRIPTION

GGC GAG AAC AGC GGC TAC ACC GTC AGC GGT GGG TTG CAC GGA GTG GGC 48  
 Gly Glu Asn Ser Gly Tyr Thr Val Ser Gly Gly Leu His Gly Val Gly  
 1 5 10 15  
 GTG TCG GTG GTC AAC GCG CTG TCC ACC CGC CTG GAG GTC ACC ATC AAG 96

EP 0 935 003 A2

	Val Ser Val Val Asn Ala Leu Ser Thr Arg Leu Glu Val Thr Ile Lys	
	20 25 30	
5	CGC GAC GGG CAC GAG TGG TTT CAG TAC TAC GAC CGC GCC GTG CCC GGA	144
	Arg Asp Gly His Glu Trp Phe Gln Tyr Tyr Asp Arg Ala Val Pro Gly	
	35 40 45	
10	ACC CTC AAG CAG GGC GAG GCC ACC AAG AAG ACC GGA ACC ACG ATC AGG	192
	Thr Leu Lys Gln Gly Glu Ala Thr Lys Lys Thr Gly Thr Thr Ile Arg	
	50 55 60	
15	TTC TGG GCG GAC CCC GAA ATC TTC GAA ACC ACA CAG TAC GAC TTC GAG	240
	Phe Trp Ala Asp Pro Glu Ile Phe Glu Thr Thr Gln Tyr Asp Phe Glu	
	65 70 75 80	
20	ACC GTG GCG CCG CCG CTG CAG GAG ATG GCC TTC CTC AAC AAG GGC CTC	288
	Thr Val Ala Arg Arg Leu Gln Glu Met Ala Phe Leu Asn Lys Gly Leu	
	85 90 95	
25	ACC ATC AAC CTC ACC GAC GAA CGA GTG GAG CAG GAC GAG GTC GTC GAC	336
	Thr Ile Asn Leu Thr Asp Glu Arg Val Glu Gln Asp Glu Val Val Asp	
	100 105 110	
30	GAG GTC GTC AGC GAC ACC GCC GAG GCA CCG AAG TCC GCC GAA GAG AAG	384
	Glu Val Val Ser Asp Thr Ala Glu Ala Pro Lys Ser Ala Glu Glu Lys	
	115 120 125	
35	GCC GCG GAA TCG ACT GCG CCA CAC AAG GTC AAG CAC CGC ACC TTC CAC	432
	Ala Ala Glu Ser Thr Ala Pro His Lys Val Lys His Arg Thr Phe His	
	130 135 140	
40	TAC CCC GGC GGT CTG GTC GAC TTC GTC AAG CAC ATC AAC CGC ACC AAG	480
	Tyr Pro Gly Gly Leu Val Asp Phe Val Lys His Ile Asn Arg Thr Lys	
	145 150 155 160	
45	AGC CCG ATC CAG CAG AGC GTC ATC GAT TTC GAC GGC AAG GGC ACC GGC	528
	Ser Pro Ile Gln Gln Ser Val Ile Asp Phe Asp Gly Lys Gly Thr Gly	
	165 170 175	
50		
55		

EP 0 935 003 A2

5 CAC GAG GTC GAG ATC GCC ATG CAG TGG AAC GGC GGC TAC TCG GAG TCC 576  
 His Glu Val Glu Ile Ala Met Gln Trp Asn Gly Gly Tyr Ser Glu Ser  
 180 185 190  
 10 GTC CAC ACC TTC GCC AAC ACC ATC AAC ACG CAC GAG GGC GGC ACC CAC 624  
 Val His Thr Phe Ala Asn Thr Ile Asn Thr His Glu Gly Gly Thr His  
 195 200 205  
 15 GAG GAG GGC TTC CGC AGC GCG CTG ACG TCG GTG GTG AAC AAG TAC GCC 672  
 Glu Glu Gly Phe Arg Ser Ala Leu Thr Ser Val Val Asn Lys Tyr Ala  
 210 215 220  
 20 AAA GAC AAG AAA CTG CTG AAG GAC AAA GAT CCC AAC CTC ACC GGT GAC 720  
 Lys Asp Lys Lys Leu Leu Lys Asp Lys Asp Pro Asn Leu Thr Gly Asp  
 225 230 235 240  
 25 GAC ATC CGT GAG GGC TTG GCC GCG GTC ATC TCG GTG AAG GTC GCC GAG 768  
 Asp Ile Arg Glu Gly Leu Ala Ala Val Ile Ser Val Lys Val Ala Glu  
 245 250 255  
 30 CCA CAG TTC GAA GGC 783  
 Pro Gln Phe Glu Gly  
 260

35

SEQ ID NO: 10

SEQUENCE LENGTH: 261

40

SEQUENCE TYPE: amino acid

TOPOLOGY: unknown

MOLECULE TYPE: protein

45

ORIGINAL SOURCE

ORGANISM: *Mycobacterium asiaticum*

STRAIN: ATCC 25274

50

SEQUENCE DESCRIPTION

Gly Glu Asn Ser Gly Tyr Thr Val Ser Gly Gly Leu His Gly Val Gly

55

EP 0 935 003 A2

	1	5	10	15
	Val	Ser Val Val Asn Ala Leu	Ser Thr Arg Leu Glu Val Thr Ile Lys	
5		20	25	30
	Arg Asp Gly His Glu Trp Phe Gln Tyr Tyr Asp Arg Ala Val Pro Gly			
	35	40	45	
10	Thr Leu Lys Gln Gly Glu Ala Thr Lys Lys Thr Gly Thr Thr Ile Arg			
	50	55	60	
	Phe Trp Ala Asp Pro Glu Ile Phe Glu Thr Thr Gln Tyr Asp Phe Glu			
15	65	70	75	80
	Thr Val Ala Arg Arg Leu Gln Glu Met Ala Phe Leu Asn Lys Gly Leu			
20		85	90	95
	Thr Ile Asn Leu Thr Asp Glu Arg Val Glu Gln Asp Glu Val Val Asp			
	100	105	110	
25	Glu Val Val Ser Asp Thr Ala Glu Ala Pro Lys Ser Ala Glu Glu Lys			
	115	120	125	
	Ala Ala Glu Ser Thr Ala Pro His Lys Val Lys His Arg Thr Phe His			
30	130	135	140	
	Tyr Pro Gly Gly Leu Val Asp Phe Val Lys His Ile Asn Arg Thr Lys			
35	145	150	155	160
	Ser Pro Ile Gln Gln Ser Val Ile Asp Phe Asp Gly Lys Gly Thr Gly			
	165	170	175	
40	His Glu Val Glu Ile Ala Met Gln Trp Asn Gly Gly Tyr Ser Glu Ser			
	180	185	190	
	Val His Thr Phe Ala Asn Thr Ile Asn Thr His Glu Gly Gly Thr His			
45	195	200	205	
	Glu Glu Gly Phe Arg Ser Ala Leu Thr Ser Val Val Asn Lys Tyr Ala			
	210	215	220	
50	Lys Asp Lys Lys Leu Leu Lys Asp Lys Asp Pro Asn Leu Thr Gly Asp			
	225	230	235	240

55

EP 0 935 003 A2

Asp Ile Arg Glu Gly Leu Ala Ala Val Ile Ser Val Lys Val Ala Glu

245

250

255

5

Pro Gln Phe Glu Gly

260

10

SEQ ID NO: 11

SEQUENCE LENGTH: 195

15

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLOGY: linear

20

MOLECULE TYPE: genomic DNA

ORIGINAL SOURCE

ORGANISM: *Cytophaga lytica*

25

STRAIN: IFO 16020

SEQUENCE DESCRIPTION

30

AGC CAC ATT GAA ACT TTA ATT CTT ACA TTC TTC TTC CGT TTT ATG CGA 48

Ser His Ile Glu Thr Leu Ile Leu Thr Phe Phe Phe Arg Phe Met Arg

1

5

10

15

35

GAA CTA ATA GAA GGC GGA CAC GTT TAC ATA GCA ACA CCA CCT TTA TAT 96

Glu Leu Ile Glu Gly Gly His Val Tyr Ile Ala Thr Pro Pro Leu Tyr

20

25

30

40

TTA GTT AAA AAA GGA ACT AAA AAG CGT TAT GCT TGG AAT GAT AAA GAA 144

Leu Val Lys Lys Gly Thr Lys Lys Arg Tyr Ala Trp Asn Asp Lys Glu

35

40

45

45

CGA GAT GAA ATA GCA GAT AGC TTT AAT GGT AGT GTA GGT ATC CAA AGA 192

Arg Asp Glu Ile Ala Asp Ser Phe Asn Gly Ser Val Gly Ile Gln Arg

50

55

60

50

TAT

195

Tyr

55

EP 0 935 003 A2

65

5

SEQ ID NO: 12

SEQUENCE LENGTH: 65

10

SEQUENCE TYPE: amino acid

TOPOLOGY: unknown

MOLECULE TYPE: protein

15

ORIGINAL SOURCE

ORGANISM: *Cytophaga lytica*

STRAIN: IFO 16020

20

SEQUENCE DESCRIPTION

Ser His Ile Glu Thr Leu Ile Leu Thr Phe Phe Phe Arg Phe Met Arg

1

5

10

15

25

Glu Leu Ile Glu Gly Gly His Val Tyr Ile Ala Thr Pro Pro Leu Tyr

20

25

30

30

Leu Val Lys Lys Gly Thr Lys Lys Arg Tyr Ala Trp Asn Asp Lys Glu

35

40

45

Arg Asp Glu Ile Ala Asp Ser Phe Asn Gly Ser Val Gly Ile Gln Arg

35

50

55

60

Tyr

65

40

SEQ ID NO: 13

45

SEQUENCE LENGTH: 1170

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

50

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

55

EP 0 935 003 A2

ORIGINAL SOURCE

ORGANISM: *Synechococcus* sp.

STRAIN: PPC 6301

SEQUENCE DESCRIPTION

5	GTG GTG GAC AAC GCC GTC GAC AAA GCC TTG GCG GGC TAC TGC AAT ACC	48
10	Val Val Asp Asn Ala Val Asp Lys Ala Leu Ala Gly Tyr Cys Asn Thr	
	1 5 10 15	
15	ATT GAT GTT CGT CTG CTC AAA GAC GGC TCC TGC CAA GTC ACC GAT AAC	96
	Ile Asp Val Arg Leu Leu Lys Asp Gly Ser Cys Gln Val Thr Asp Asn	
	20 25 30	
20	GGT CGC GGC ATT CCC ACA GAT ATT CAC CCC CAA ACC GGG AAG TCT GCT	144
	Gly Arg Gly Ile Pro Thr Asp Ile His Pro Gln Thr Gly Lys Ser Ala	
	35 40 45	
25	CTC GAA ACC GTG CTG ACG ATT CTG CAC GCG GGC GGC AAG TTT GGC GGT	192
	Leu Glu Thr Val Leu Thr Ile Leu His Ala Gly Gly Lys Phe Gly Gly	
	50 55 60	
30	GGC GGT TAT AAG GTG TCG GGG GGT CTG CAC GGC GTC GGT GTG TCT GTC	240
	Gly Gly Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val Ser Val	
	65 70 75 80	
35	GTC AAC GCC CTC TCA GAA TAT GTC GAA GTC ACC GTG TGG CGG GAA GGC	288
	Val Asn Ala Leu Ser Glu Tyr Val Glu Val Thr Val Trp Arg Glu Gly	
	85 90 95	
40	AAA ACC CAC CAA CAG CGC TTT GAA CAG GGC AAC CCG ATC GGG GAG TTG	336
	Lys Thr His Gln Gln Arg Phe Glu Gln Gly Asn Pro Ile Gly Glu Leu	
	100 105 110	
45	CAA GTT GCC CCG GAT GCC GAC GAT CGC CGC GGG ACA CAA GTT CGT TTC	384
	Gln Val Ala Pro Asp Ala Asp Asp Arg Arg Gly Thr Gln Val Arg Phe	
	115 120 125	
50	AAA CCA GAC GCC ACG ATC TTT TCT GAA ACA ACC GAG TTC GAT TAC GGC	432

55

EP 0 935 003 A2

Lys Pro Asp Ala Thr Ile Phe Ser Glu Thr Thr Glu Phe Asp Tyr Gly  
 130 135 140  
 5 ACC CTA GCA AGC CGA TTG AAG GAG CTA GCC TAT CTG AAT GCG GGC GTC 480  
 Thr Leu Ala Ser Arg Leu Lys Glu Leu Ala Tyr Leu Asn Ala Gly Val  
 145 150 155 160  
 10 CGC ATC GAC TTT ACC GAT GAG CGG CTG CAG CTC ACC AAG AAT CAC GAG 528  
 Arg Ile Asp Phe Thr Asp Glu Arg Leu Gln Leu Thr Lys Asn His Glu  
 165 170 175  
 15 CCC CAT CAA GAA ACC TAT TAC TTT GAA GGC GGT ATT CGC GAA TAC GTC 576  
 Pro His Gln Glu Thr Tyr Tyr Phe Glu Gly Gly Ile Arg Glu Tyr Val  
 180 185 190  
 20 GCC TAC ATG AAT ACC GAT AAA CAG GCG CTG CAC TCA GAG ATT ATC TTT 624  
 Ala Tyr Met Asn Thr Asp Lys Gln Ala Leu His Ser Glu Ile Ile Phe  
 195 200 205  
 25 GTG CAA TCC GAA AAA GAT GGC GTC CAA GTT GAA GCT GCA TTG CAA TGG 672  
 Val Gln Ser Glu Lys Asp Gly Val Gln Val Glu Ala Ala Leu Gln Trp  
 210 215 220  
 30 TGC GTT GAC GCC TAC AGC GAC AAC ATT CTG GGC TTT GCC AAC AAC ATC 720  
 Cys Val Asp Ala Tyr Ser Asp Asn Ile Leu Gly Phe Ala Asn Asn Ile  
 225 230 235 240  
 35 CGC ACG ATT GAC GGC GGC ACC CAT ATT GAG GGG CTC AAA ACT GTT CTG 768  
 Arg Thr Ile Asp Gly Gly Thr His Ile Glu Gly Leu Lys Thr Val Leu  
 245 250 255  
 40 ACG CGG ACG ATG AAC ACG ATC GCC CGC AAA CGG AAT AAA CGC AAG GAT 816  
 Thr Arg Thr Met Asn Thr Ile Ala Arg Lys Arg Asn Lys Arg Lys Asp  
 260 265 270  
 45 GCC GAC AAT AAC CTG TCG GGC GAG AAT ATT CGC GAA GGG TTA ACA GCG 864  
 Ala Asp Asn Asn Leu Ser Gly Glu Asn Ile Arg Glu Gly Leu Thr Ala  
 275 280 285  
 50  
 55



EP 0 935 003 A2

5           ATC GTT TCG GTC AAA GTT CCG GAT CCG GAA TTT GAA GGG CAA ACC AAA   912  
           Ile Val Ser Val Lys Val Pro Asp Pro Glu Phe Glu Gly Gln Thr Lys  
           290                           295                           300  
           ACA AAG CTC GGC AAT ACC GAA GTT CGC GGC ATC GTC GAT ACG CTC GTG   960  
 10          Thr Lys Leu Gly Asn Thr Glu Val Arg Gly Ile Val Asp Thr Leu Val  
           305                           310                           315                           320  
           GGC GAA ACG TTG ACG GAA TAT CTG GAA TTC CAT CCC AGC GTT GCC GAT 1008  
 15          Gly Glu Thr Leu Thr Glu Tyr Leu Glu Phe His Pro Ser Val Ala Asp  
    325                           330                           335  
           TTG ATC CTC GAA AAA GCG ATT CAA GCC TTT AAT GCG GCT GAG GCA GCG 1056  
 20          Leu Ile Leu Glu Lys Ala Ile Gln Ala Phe Asn Ala Ala Glu Ala Ala  
    340                           345                           350  
           CGA CGG GCA CGG GAA TTG GTG CGT CGC AAA TCA GTG CTG GAA TCT TCG 1104  
 25          Arg Arg Ala Arg Glu Leu Val Arg Arg Lys Ser Val Leu Glu Ser Ser  
    355                           360                           365  
           ACA TTG CCC GGT AAA TTA GCA GAC TGT TCC AGT CGC GAT CCC GGT GAA 1152  
 30          Thr Leu Pro Gly Lys Leu Ala Asp Cys Ser Ser Arg Asp Pro Gly Glu  
    370                           375                           380  
 35          TCT GAA ATC TTC ATC GTG   1170  
           Ser Glu Ile Phe Ile Val  
           385                           390

40           SEQ ID NO: 14  
           SEQUENCE LENGTH: 390  
 45           SEQUENCE TYPE: amino acid  
           TOPOLOGY: unknown  
           MOLECULE TYPE: protein  
 50           ORIGINAL SOURCE  
           ORGANISM: *Synechococcus* sp.

55

EP 0 935 003 A2

STRAIN: PCC 6301

SEQUENCE DESCRIPTION

5 Val Val Asp Asn Ala Val Asp Lys Ala Leu Ala Gly Tyr Cys Asn Thr  
1 5 10 15  
10 Ile Asp Val Arg Leu Leu Lys Asp Gly Ser Cys Gln Val Thr Asp Asn  
20 25 30  
Gly Arg Gly Ile Pro Thr Asp Ile His Pro Gln Thr Gly Lys Ser Ala  
15 35 40 45  
Leu Glu Thr Val Leu Thr Ile Leu His Ala Gly Gly Lys Phe Gly Gly  
50 55 60  
20 Gly Gly Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val Ser Val  
65 70 75 80  
Val Asn Ala Leu Ser Glu Tyr Val Glu Val Thr Val Trp Arg Glu Gly  
25 85 90 95  
Lys Thr His Gln Gln Arg Phe Glu Gln Gly Asn Pro Ile Gly Glu Leu  
100 105 110  
30 Gln Val Ala Pro Asp Ala Asp Asp Arg Arg Gly Thr Gln Val Arg Phe  
115 120 125  
35 Lys Pro Asp Ala Thr Ile Phe Ser Glu Thr Thr Glu Phe Asp Tyr Gly  
130 135 140  
Thr Leu Ala Ser Arg Leu Lys Glu Leu Ala Tyr Leu Asn Ala Gly Val  
40 145 150 155 160  
Arg Ile Asp Phe Thr Asp Glu Arg Leu Gln Leu Thr Lys Asn His Glu  
165 170 175  
45 Pro His Gln Glu Thr Tyr Tyr Phe Glu Gly Gly Ile Arg Glu Tyr Val  
180 185 190  
Ala Tyr Met Asn Thr Asp Lys Gln Ala Leu His Ser Glu Ile Ile Phe  
50 195 200 205  
Val Gln Ser Glu Lys Asp Gly Val Gln Val Glu Ala Ala Leu Gln Trp

55

EP 0 935 003 A2

	210	215	220	
5	Cys Val Asp Ala Tyr Ser Asp Asn Ile Leu Gly Phe Ala Asn Asn Ile			
	225	230	235	240
	Arg Thr Ile Asp Gly Gly Thr His Ile Glu Gly Leu Lys Thr Val Leu			
10		245	250	255
	Thr Arg Thr Met Asn Thr Ile Ala Arg Lys Arg Asn Lys Arg Lys Asp			
		260	265	270
15	Ala Asp Asn Asn Leu Ser Gly Glu Asn Ile Arg Glu Gly Leu Thr Ala			
		275	280	285
	Ile Val Ser Val Lys Val Pro Asp Pro Glu Phe Glu Gly Gln Thr Lys			
20		290	295	300
	Thr Lys Leu Gly Asn Thr Glu Val Arg Gly Ile Val Asp Thr Leu Val			
	305	310	315	320
25	Gly Glu Thr Leu Thr Glu Tyr Leu Glu Phe His Pro Ser Val Ala Asp			
		325	330	335
	Leu Ile Leu Glu Lys Ala Ile Gln Ala Phe Asn Ala Ala Glu Ala Ala			
30		340	345	350
	Arg Arg Ala Arg Glu Leu Val Arg Arg Lys Ser Val Leu Glu Ser Ser			
		355	360	365
35	Thr Leu Pro Gly Lys Leu Ala Asp Cys Ser Ser Arg Asp Pro Gly Glu			
		370	375	380
40	Ser Glu Ile Phe Ile Val			
	385	390		

45 SEQ ID NO: 15

SEQUENCE LENGTH: 696

SEQUENCE TYPE: nucleic acid

50 STRANDEDNESS: double

TOPOLOGY: linear

55

EP 0 935 003 A2

MOLECULE TYPE: genomic DNA

ORIGINAL SOURCE

5

ORGANISM: *Caulobacter crescentus*

STRAIN: ATCC 15252

10

SEQUENCE DESCRIPTION

15

CAG AAC AGC TAC AAG GTC TCG GGC GGT CTG CAC GGC GTG GGC GTC TCG 48

Gln Asn Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val Ser

20

1 5 10 15  
GTC GTG AAC GCC CTG TCG GAT TGG CTG GAG CTG CTG ATC CAC CGC AAC 96

Val Val Asn Ala Leu Ser Asp Trp Leu Glu Leu Leu Ile His Arg Asn

25

20 25 30  
GGC AAG GTC CAC CAG ATG CGC TTC GAG CGC GGC GAC GCG GTC ACC TCG 144

Gly Lys Val His Gln Met Arg Phe Glu Arg Gly Asp Ala Val Thr Ser

30

35 40 45  
CTG AAG GTC ACC GGC GAC TCG CCC GTG CGG ACC GAG GGC CCC AAG GCC 192

Leu Lys Val Thr Gly Asp Ser Pro Val Arg Thr Glu Gly Pro Lys Ala

35

50 55 60  
GGC GAG ACC CTG ACC GGT ACG GAA GTT ACG TTC TTT CCG TCG AAG GAC 240

Gly Glu Thr Leu Thr Gly Thr Glu Val Thr Phe Phe Pro Ser Lys Asp

40

65 70 75 80  
ACC TTC GCC TTC ATC GAA TTC GAC CGG AAG ACG CTG GAG CAC CGC CTG 288

Thr Phe Ala Phe Ile Glu Phe Asp Arg Lys Thr Leu Glu His Arg Leu

45

85 90 95  
CGC GAG CTG GCC TTC CTG AAC TCG GGC GTG ACG ATC TGG TTC AAG GAC 336

Arg Glu Leu Ala Phe Leu Asn Ser Gly Val Thr Ile Trp Phe Lys Asp

50

100 105 110  
CAT CGC GAC GTC GAG CCG TGG GAA GAG AAG CTG TTC TAC GAG GGC GGC 384

His Arg Asp Val Glu Pro Trp Glu Glu Lys Leu Phe Tyr Glu Gly Gly

55

115 120 125

EP 0 935 003 A2

5           ATC GAG GCC TTC GTG CGC CAC CTC GAC AAG GCC AAG ACG COG CTG CTG   432  
           Ile Glu Ala Phe Val Arg His Leu Asp Lys Ala Lys Thr Pro Leu Leu  
           130                   135                   140  
           AAG GCC CCG ATC GCC GTC AAG GGC GTC AAG GAC AAG GTC GAG ATC GAC   480  
 10          Lys Ala Pro Ile Ala Val Lys Gly Val Lys Asp Lys Val Glu Ile Asp  
           145                   150                   155                   160  
           CTG GCC CTG TGG TGG AAC GAC AGC TAC CAC GAG CAG ATG CTG TGC TTC   528  
 15          Leu Ala Leu Trp Trp Asn Asp Ser Tyr His Glu Gln Met Leu Cys Phe  
           165                   170                   175  
           ACC AAC AAC ATC CCG CAG CGG GAT GGC GGC ACG CAC CTG TCG GCC TTT   576  
 20          Thr Asn Asn Ile Pro Gln Arg Asp Gly Gly Thr His Leu Ser Ala Phe  
           180                   185                   190  
           CGC GCG GCC CTG ACC CGG ATC ATC ACC AGC TAC GCC GAG AGC TCC GGC   624  
 25          Arg Ala Ala Leu Thr Arg Ile Ile Thr Ser Tyr Ala Glu Ser Ser Gly  
           195                   200                   205  
           ATC CTG AAG AAG GAA AAG GTC AGC CTG GGC GGC GAA GAC AGC CGC GAG   672  
 30          Ile Leu Lys Lys Glu Lys Val Ser Leu Gly Gly Glu Asp Ser Arg Glu  
           210                   215                   220  
           GGC CTG ACC TGC GTG CTG TCG GTC                                   696  
 35          Gly Leu Thr Cys Val Leu Ser Val  
           225                   230

40

SEQ ID NO: 16

SEQUENCE LENGTH: 232

45

SEQUENCE TYPE: amino acid

TOPOLOGY: unknown

MOLECULE TYPE: protein

50

ORIGINAL SOURCE

ORGANISM: *Caulobacter crescentus*

55

EP 0 935 003 A2

STRAIN: ATCC 15252

SEQUENCE DESCRIPTION

5  
Gln Asn Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val Ser  
1 5 10 15  
10 Val Val Asn Ala Leu Ser Asp Trp Leu Glu Leu Leu Ile His Arg Asn  
20 25 30  
Gly Lys Val His Gln Met Arg Phe Glu Arg Gly Asp Ala Val Thr Ser  
15 35 40 45  
Leu Lys Val Thr Gly Asp Ser Pro Val Arg Thr Glu Gly Pro Lys Ala  
50 55 60  
20 Gly Glu Thr Leu Thr Gly Thr Glu Val Thr Phe Phe Pro Ser Lys Asp  
65 70 75 80  
Thr Phe Ala Phe Ile Glu Phe Asp Arg Lys Thr Leu Glu His Arg Leu  
25 85 90 95  
Arg Glu Leu Ala Phe Leu Asn Ser Gly Val Thr Ile Trp Phe Lys Asp  
100 105 110  
30 His Arg Asp Val Glu Pro Trp Glu Glu Lys Leu Phe Tyr Glu Gly Gly  
115 120 125  
35 Ile Glu Ala Phe Val Arg His Leu Asp Lys Ala Lys Thr Pro Leu Leu  
130 135 140  
Lys Ala Pro Ile Ala Val Lys Gly Val Lys Asp Lys Val Glu Ile Asp  
40 145 150 155 160  
Leu Ala Leu Trp Trp Asn Asp Ser Tyr His Glu Gln Met Leu Cys Phe  
165 170 175  
45 Thr Asn Asn Ile Pro Gln Arg Asp Gly Gly Thr His Leu Ser Ala Phe  
180 185 190  
Arg Ala Ala Leu Thr Arg Ile Ile Thr Ser Tyr Ala Glu Ser Ser Gly  
50 195 200 205  
Ile Leu Lys Lys Glu Lys Val Ser Leu Gly Gly Glu Asp Ser Arg Glu  
55

EP 0 935 003 A2

210 215 220

5 Gly Leu Thr Cys Val Leu Ser Val

225 230

10 SEQ ID NO: 17

SEQUENCE LENGTH: 888

SEQUENCE TYPE: nucleic acid

15 STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

20 ORIGINAL SOURCE

ORGANISM: *Pseudomonas putida*

STRAIN: ATCC 17484

25 SEQUENCE DESCRIPTION

GGC GGC CTG CAC GGT GTA GGC GTG TCG GTA GTG AAC GCA CTG TCT GAA 48

Gly Gly Leu His Gly Val Gly Val Ser Val Val Asn Ala Leu Ser Glu

30 1 5 10 15

GAG CTC GTC CTC ACC GTT CGC CGT AGC GGC AAG ATC TGG GAA CAG ACC 96

Glu Leu Val Leu Thr Val Arg Arg Ser Gly Lys Ile Trp Glu Gln Thr

35 20 25 30

TAC GTC CAT GGT GTT CCG CAG GAA CCG ATG AAG ATC GTT GGC GAC AGC 144

Tyr Val His Gly Val Pro Gln Glu Pro Met Lys Ile Val Gly Asp Ser

40 35 40 45

GAA ACC ACC GGC ACC CAG ATC CAC TTC AAG GCT TCC AGC GAA ACC TTC 192

Glu Thr Thr Gly Thr Gln Ile His Phe Lys Ala Ser Ser Glu Thr Phe

45 50 55 60

AAG AAC ATC CAC TTC AGC TGG GAC ATC CTG GCC AAG CCG ATT CGT GAA 240

Lys Asn Ile His Phe Ser Trp Asp Ile Leu Ala Lys Arg Ile Arg Glu

50 65 70 75 80

55

EP 0 935 003 A2

CTG TCC TTC CTC AAC TCC GGT GTC GGC ATC GTC CTC AAG GAT GAG CGC 288  
5 Leu Ser Phe Leu Asn Ser Gly Val Gly Ile Val Leu Lys Asp Glu Arg  
85 90 95  
AGC GGC AAG GAA GAA CTG TTC AAG TAC GAA GGC GGC TTG CGC GCG TTC 336  
10 Ser Gly Lys Glu Glu Leu Phe Lys Tyr Glu Gly Gly Leu Arg Ala Phe  
100 105 110  
GTT GAA TAC CTG AAC ACC AAC AAG ACC CCG GTC AAC CAG GTG TTC CAT 384  
15 Val Glu Tyr Leu Asn Thr Asn Lys Thr Pro Val Asn Gln Val Phe His  
115 120 125  
TTC AAC ATC CAG CGC GAA GAC GGC ATC GGC GTA GAA ATC GCC CTG CAG 432  
20 Phe Asn Ile Gln Arg Glu Asp Gly Ile Gly Val Glu Ile Ala Leu Gln  
130 135 140  
TGG AAC GAC AGC TTC AAC GAG AAC CTG TTG TGC TTC ACC AAC AAC ATT 480  
25 Trp Asn Asp Ser Phe Asn Glu Asn Leu Leu Cys Phe Thr Asn Asn Ile  
145 150 155 160  
CCG CAG CGC GAT GGC GGT ACT CAC CTG GTG GGT TTC CGT TCC GCC CTG 528  
30 Pro Gln Arg Asp Gly Gly Thr His Leu Val Gly Phe Arg Ser Ala Leu  
165 170 175  
ACG CGT AAC CTC AAT ACG TAT ATC GAA GCC GAA GGC CTG GCG AAG AAG 576  
35 Thr Arg Asn Leu Asn Thr Tyr Ile Glu Ala Glu Gly Leu Ala Lys Lys  
180 185 190  
CAC AAG GTC GCG ACC ACC GGT GAC GAT GCC CGT GAA GGC CTG GCC GCG 624  
40 His Lys Val Ala Thr Thr Gly Asp Asp Ala Arg Glu Gly Leu Ala Ala  
195 200 205  
ATC ATT TCG GTA AAA GTG CCG GAT CCG AAG TTC AGC TCC CAG ACC AAG 672  
45 Ile Ile Ser Val Lys Val Pro Asp Pro Lys Phe Ser Ser Gln Thr Lys  
210 215 220  
50 GAC AAG CTG GTT TCT TCC GAA GTG AAG ACC GCG GTC GAA CAG GAA ATG 720  
Asp Lys Leu Val Ser Ser Glu Val Lys Thr Ala Val Glu Gln Glu Met

55



EP 0 935 003 A2

225 230 235 240  
 5 GGC AAG TAC TTC TCC GAC TTC CTG CTG GAA AAC CCG AAC GAA GCC AAG 768  
 Gly Lys Tyr Phe Ser Asp Phe Leu Leu Glu Asn Pro Asn Glu Ala Lys  
 245 250 255  
 10 CTG GTT GTC GGC AAG ATG ATC GAC GCG GCA CGT GCT CGT GAA GCG GCG 816  
 Leu Val Val Gly Lys Met Ile Asp Ala Ala Arg Ala Arg Glu Ala Ala  
 260 265 270  
 15 CGC AAG ACC CGT GAG ATG ACC CGC CGC AAA GGC GCG CTG GAC ATC GCC 864  
 Arg Lys Thr Arg Glu Met Thr Arg Arg Lys Gly Ala Leu Asp Ile Ala  
 275 280 285  
 20 GGC CTG CCG GGC AAA CTG GCT GAC 888  
 Gly Leu Pro Gly Lys Leu Ala Asp  
 290 295

25  
 SEQ ID NO: 18  
 30 SEQUENCE LENGTH: 296  
 SEQUENCE TYPE: amino acid  
 TOPOLOGY: unknown  
 35 MOLECULE TYPE: protein  
 ORIGINAL SOURCE  
 ORGANISM: *Pseudomonas putida*  
 40 STRAIN: ATCC 17484

SEQUENCE DESCRIPTION  
 Gly Gly Leu His Gly Val Gly Val Ser Val Val Asn Ala Leu Ser Glu  
 45 1 5 10 15  
 Glu Leu Val Leu Thr Val Arg Arg Ser Gly Lys Ile Trp Glu Gln Thr  
 20 25 30  
 50 Tyr Val His Gly Val Pro Gln Glu Pro Met Lys Ile Val Gly Asp Ser  
 35 40 45

55

EP 0 935 003 A2

Glu Thr Thr Gly Thr Gln Ile His Phe Lys Ala Ser Ser Glu Thr Phe  
 50 55 60  
 Lys Asn Ile His Phe Ser Trp Asp Ile Leu Ala Lys Arg Ile Arg Glu  
 65 70 75 80  
 Leu Ser Phe Leu Asn Ser Gly Val Gly Ile Val Leu Lys Asp Glu Arg  
 85 90 95  
 Ser Gly Lys Glu Glu Leu Phe Lys Tyr Glu Gly Gly Leu Arg Ala Phe  
 100 105 110  
 Val Glu Tyr Leu Asn Thr Asn Lys Thr Pro Val Asn Gln Val Phe His  
 115 120 125  
 Phe Asn Ile Gln Arg Glu Asp Gly Ile Gly Val Glu Ile Ala Leu Gln  
 130 135 140  
 Trp Asn Asp Ser Phe Asn Glu Asn Leu Leu Cys Phe Thr Asn Asn Ile  
 145 150 155 160  
 Pro Gln Arg Asp Gly Gly Thr His Leu Val Gly Phe Arg Ser Ala Leu  
 165 170 175  
 Thr Arg Asn Leu Asn Thr Tyr Ile Glu Ala Glu Gly Leu Ala Lys Lys  
 180 185 190  
 His Lys Val Ala Thr Thr Gly Asp Asp Ala Arg Glu Gly Leu Ala Ala  
 195 200 205  
 Ile Ile Ser Val Lys Val Pro Asp Pro Lys Phe Ser Ser Gln Thr Lys  
 210 215 220  
 Asp Lys Leu Val Ser Ser Glu Val Lys Thr Ala Val Glu Gln Glu Met  
 225 230 235 240  
 Gly Lys Tyr Phe Ser Asp Phe Leu Leu Glu Asn Pro Asn Glu Ala Lys  
 245 250 255  
 Leu Val Val Gly Lys Met Ile Asp Ala Ala Arg Ala Arg Glu Ala Ala  
 260 265 270  
 Arg Lys Thr Arg Glu Met Thr Arg Arg Lys Gly Ala Leu Asp Ile Ala

EP 0 935 003 A2

275 280 285

Gly Leu Pro Gly Lys Leu Ala Asp

5 290 295

10 SEQ ID NO: 19

SEQUENCE LENGTH: 531

SEQUENCE TYPE: nucleic acid

15 STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

20 ORIGINAL SOURCE

ORGANISM: *Synechococcus* sp.

STRAIN: PCC 6301

25 SEQUENCE DESCRIPTION

TTG GTG CGT CGC AAA TCA GTG CTG GAA TCT TCG ACA TTG CCC GGT AAA 48

Leu Val Arg Arg Lys Ser Val Leu Glu Ser Ser Thr Leu Pro Gly Lys

30 1 5 10 15

TTA GCA GAC TGT TCC AGT CGC GAT CCC GGT GAA TCT GAA ATC TTC ATC 96

Leu Ala Asp Cys Ser Ser Arg Asp Pro Gly Glu Ser Glu Ile Phe Ile

35 20 25 30

GTG GAA GGG GAT TCG GCA GGT GGC AGT GCT AAA CAG GGG CGC GAT CGC 144

40 Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Gly Arg Asp Arg

35 40 45

CGC TTC CAA GCC ATC CTG CCT CTG CGC GGC AAA ATC CTC AAC ATC GAG 192

45 Arg Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu Asn Ile Glu

50 55 60

AAA ACG GAC GAT GCC AAA ATC TAC AAA AAC ACT GAG ATC CAA GCC CTG 240

50 Lys Thr Asp Asp Ala Lys Ile Tyr Lys Asn Thr Glu Ile Gln Ala Leu

65 70 75 80

55

**EP 0 935 003 A2**

	ATT ACA GCG CTG GGC CTC GGA ATT AAA GGG GAG GAA TTT GAT GCT TCC	288
5	Ile Thr Ala Leu Gly Leu Gly Ile Lys Gly Glu Glu Phe Asp Ala Ser	
	85 90 95	
	CAA CTG CGC TAC CAC CGT ATT GTG ATC ATG ACT GAC GCG GAC GTC GAT	336
10	Gln Leu Arg Tyr His Arg Ile Val Ile Met Thr Asp Ala Asp Val Asp	
	100 105 110	
	GGT GCG CAC ATC CGT ACC CTC TTG CTC ACC TTC TTC TAT CGC TAT CAG	384
15	Gly Ala His Ile Arg Thr Leu Leu Leu Thr Phe Phe Tyr Arg Tyr Gln	
	115 120 125	
	CGA TCG CTG CTG GAG CAG GGC TAC ATG TAC ATT GCC TGC CCG CCG CTG	432
20	Arg Ser Leu Leu Glu Gln Gly Tyr Met Tyr Ile Ala Cys Pro Pro Leu	
	130 135 140	
	TAC AAG TTG GAG CGG GGA CGT AAT CAC TAC TAT TGC TAC AAC GAA CGC	480
25	Tyr Lys Leu Glu Arg Gly Arg Asn His Tyr Tyr Cys Tyr Asn Glu Arg	
	145 150 155 160	
	GAA CTG CAG GAA CGG ATT GCG ACG TTC CCT GAA AAC GCC AAC TAT ACG	528
30	Glu Leu Gln Glu Arg Ile Ala Thr Phe Pro Glu Asn Ala Asn Tyr Thr	
	165 170 175	
35	ATT	531
	Ile	

40 SEQ ID NO: 20

SEQUENCE LENGTH: 177

SEQUENCE TYPE: amino acid

45 TOPOLOGY: unknown

MOLECULE TYPE: protein

ORIGINAL SOURCE

50 ORGANISM: *Synechococcus* sp.

STRAIN: PCC 6301

EP 0 935 003 A2

SEQUENCE DESCRIPTION

5 Leu Val Arg Arg Lys Ser Val Leu Glu Ser Ser Thr Leu Pro Gly Lys  
1 5 10 15  
10 Leu Ala Asp Cys Ser Ser Arg Asp Pro Gly Glu Ser Glu Ile Phe Ile  
20 25 30  
15 Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Gly Arg Asp Arg  
35 40 45  
Arg Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile Leu Asn Ile Glu  
50 55 60  
20 Lys Thr Asp Asp Ala Lys Ile Tyr Lys Asn Thr Glu Ile Gln Ala Leu  
65 70 75 80  
25 Ile Thr Ala Leu Gly Leu Gly Ile Lys Gly Glu Glu Phe Asp Ala Ser  
85 90 95  
30 Gln Leu Arg Tyr His Arg Ile Val Ile Met Thr Asp Ala Asp Val Asp  
100 105 110  
Gly Ala His Ile Arg Thr Leu Leu Leu Thr Phe Phe Tyr Arg Tyr Gln  
35 115 120 125  
Arg Ser Leu Leu Glu Gln Gly Tyr Met Tyr Ile Ala Cys Pro Pro Leu  
40 130 135 140  
Tyr Lys Leu Glu Arg Gly Arg Asn His Tyr Tyr Cys Tyr Asn Glu Arg  
145 150 155 160  
45 Glu Leu Gln Glu Arg Ile Ala Thr Phe Pro Glu Asn Ala Asn Tyr Thr  
165 170 175  
50 Ile

55

EP 0 935 003 A2

SEQ ID NO: 21

SEQUENCE LENGTH: 660

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: double

TOPOLOGY: linear

MOLECULE TYPE: genomic DNA

ORIGINAL SOURCE

ORGANISM: *Caulobacter crescentus*

STRAIN: ATCC 15252

SEQUENCE DESCRIPTION

20	CGG GAT GGC GGC ACG CAC CTG TCG GCC TTT CGC GCG GCC CTG ACC CGG	48
	Arg Asp Gly Gly Thr His Leu Ser Ala Phe Arg Ala Ala Leu Thr Arg	
	1 5 10 15	
25	ATC ATC ACC AGC TAC GCC GAG AGC TCC GGC ATC CTG AAG AAG GAA AAG	96
	Ile Ile Thr Ser Tyr Ala Glu Ser Ser Gly Ile Leu Lys Lys Glu Lys	
	20 25 30	
30	GTC AGC CTG GGC GGC GAA GAC AGC CGC GAG GGC CTG ACC TGC GTG CTG	144
	Val Ser Leu Gly Gly Glu Asp Ser Arg Glu Gly Leu Thr Cys Val Leu	
	35 40 45	
35	TCG GTC AAG GTC CCG GAT CCG AAG TTC AGC TCG CAG ACC AAG GAC AAG	192
	Ser Val Lys Val Pro Asp Pro Lys Phe Ser Ser Gln Thr Lys Asp Lys	
40	50 55 60	
	CTG GTC TCG TCC GAA GTG CGC CCC GCC GTT GAG GGC CTG GTG TCG GAA	240
	Leu Val Ser Ser Glu Val Arg Pro Ala Val Glu Gly Leu Val Ser Glu	
45	65 70 75 80	
	GGT CTC TCG ACC TGG TTC GAG GAA CAT CCG AAC GAG GCC AAG GCG ATC	288
	Gly Leu Ser Thr Trp Phe Glu Glu His Pro Asn Glu Ala Lys Ala Ile	
50	85 90 95	
	GTG ACC AAG ATC GCC GAG GCC GCC GCC GCC CGC GAG GCC GCC CGC AAG	336

EP 0 935 003 A2

Val Thr Lys Ile Ala Glu Ala Ala Ala Arg Glu Ala Ala Arg Lys  
100 105 110  
5 GCG CGA GAG CTG ACC CGC CGC AAG AGC GCG CTC GAC ATC ACC AGC CTG 384  
Ala Arg Glu Leu Thr Arg Arg Lys Ser Ala Leu Asp Ile Thr Ser Leu  
115 120 125  
10 CCC GGC AAG CTC GCC GAC TGC TCG GAA CGC GAT CCG GCC AAG TCC GAG 432  
Pro Gly Lys Leu Ala Asp Cys Ser Glu Arg Asp Pro Ala Lys Ser Glu  
130 135 140  
15 ATC TTC ATC GTC GAG GGC GAC TCG GCG GGC GGC TCG GCC AAG CAG GCC 480  
Ile Phe Ile Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Ala  
145 150 155 160  
20 CGC AAC CGC GAC AAC CAG GCC GTT CTG CCC CTG CGC GGC AAG ATC CTG 528  
Arg Asn Arg Asp Asn Gln Ala Val Leu Pro Leu Arg Gly Lys Ile Leu  
165 170 175  
25 AAC GTC GAG CGG GCC CGC TTC GAC AAG ATG CTG TCG TCC GAC CAG ATC 576  
Asn Val Glu Arg Ala Arg Phe Asp Lys Met Leu Ser Ser Asp Gln Ile  
180 185 190  
30 GGC ACG CTG ATC ACC GCC CTG GGC GCG GGG ATC GGC CGC GAC GAC TTC 624  
Gly Thr Leu Ile Thr Ala Leu Gly Ala Gly Ile Gly Arg Asp Asp Phe  
195 200 205  
35 AAC CCG GAC AAG GTG CGC TAC CAC AAG ATC GTG CTG 660  
40 Asn Pro Asp Lys Val Arg Tyr His Lys Ile Val Leu  
210 215 220

45 SEQ ID NO: 22  
SEQUENCE LENGTH: 220  
SEQUENCE TYPE: amino acid  
50 TOPOLOGY: unknown  
MOLECULE TYPE: protein  
55

EP 0 935 003 A2

ORIGINAL SOURCE

ORGANISM: *Caulobacter crescentius*

STRAIN: ATCC 15252

SEQUENCE DESCRIPTION

Arg Asp Gly Gly Thr His Leu Ser Ala Phe Arg Ala Ala Leu Thr Arg  
1 5 10 15  
Ile Ile Thr Ser Tyr Ala Glu Ser Ser Gly Ile Leu Lys Lys Glu Lys  
15 20 25 30  
Val Ser Leu Gly Gly Glu Asp Ser Arg Glu Gly Leu Thr Cys Val Leu  
35 40 45  
Ser Val Lys Val Pro Asp Pro Lys Phe Ser Ser Gln Thr Lys Asp Lys  
50 55 60  
Leu Val Ser Ser Glu Val Arg Pro Ala Val Glu Gly Leu Val Ser Glu  
25 65 70 75 80  
Gly Leu Ser Thr Trp Phe Glu Glu His Pro Asn Glu Ala Lys Ala Ile  
85 90 95  
Val Thr Lys Ile Ala Glu Ala Ala Ala Arg Glu Ala Ala Arg Lys  
100 105 110  
Ala Arg Glu Leu Thr Arg Arg Lys Ser Ala Leu Asp Ile Thr Ser Leu  
115 120 125  
Pro Gly Lys Leu Ala Asp Cys Ser Glu Arg Asp Pro Ala Lys Ser Glu  
40 130 135 140  
Ile Phe Ile Val Glu Gly Asp Ser Ala Gly Gly Ser Ala Lys Gln Ala  
145 150 155 160  
Arg Asn Arg Asp Asn Gln Ala Val Leu Pro Leu Arg Gly Lys Ile Leu  
165 170 175  
Asn Val Glu Arg Ala Arg Phe Asp Lys Met Leu Ser Ser Asp Gln Ile  
50 180 185 190  
Gly Thr Leu Ile Thr Ala Leu Gly Ala Gly Ile Gly Arg Asp Asp Phe



EP 0 935 003 A2

195 200 205  
 Asn Pro Asp Lys Val Arg Tyr His Lys Ile Val Leu  
 5 210 215 220

SEQ ID NO: 23  
 SEQUENCE LENGTH: 1422  
 SEQUENCE TYPE: nucleic acid  
 STRANDEDNESS: double  
 TOPOLOGY: linear  
 MOLECULE TYPE: genomic DNA  
 ORIGINAL SOURCE  
 ORGANISM: *Cytophaga lytica*  
 STRAIN: MBIC 1544

SEQUENCE DESCRIPTION

GAT AAA GAT TCA TAC AAA GTA TCT GGT GGT TTA CAC GGT GTA GGT GTA	48
Asp Lys Asp Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val	
1 5 10 15	
TCT TGT GTA AAC GCA TTA TCT AAT AAT TTA AAA GCT ACT GTT TAC AGA	96
Ser Cys Val Asn Ala Leu Ser Asn Asn Leu Lys Ala Thr Val Tyr Arg	
20 25 30	
GAA GGT AAA ATA TGG GAG CAA GAG TAT GAA AGA GGT AAG GCT TTA TAT	144
Glu Gly Lys Ile Trp Glu Gln Glu Tyr Glu Arg Gly Lys Ala Leu Tyr	
35 40 45	
CCG GTA AAA AGT ATT GGA GAA ACA GAG GAA ACA GGT ACT ATA GTT ACT	192
Pro Val Lys Ser Ile Gly Glu Thr Glu Glu Thr Gly Thr Ile Val Thr	
50 55 60	
TTT TAC CCA GAT GAT ACT ATA TTT ACA CAA ACT ACA GAG TAT AAT TAT	240
Phe Tyr Pro Asp Asp Thr Ile Phe Thr Gln Thr Thr Glu Tyr Asn Tyr	
65 70 75 80	

EP 0 935 003 A2

	GAA ACG CTT TCT AAC AGA ATG CGA GAG TTG GCT TAC CTT AAT AAG GGA	288
5	Glu Thr Leu Ser Asn Arg Met Arg Glu Leu Ala Tyr Leu Asn Lys Gly	
	85 90 95	
	GTT ACA ATT AGC ATT ACA GAT AAG AGA GTT AAA GAT GAA AAG GGA GAG	336
10	Val Thr Ile Ser Ile Thr Asp Lys Arg Val Lys Asp Glu Lys Gly Glu	
	100 105 110	
	TTT TTA TCT GAA GTT TTT TAC TCT GAA GAA GGA CTA AAA GAA TTT ATT	384
15	Phe Leu Ser Glu Val Phe Tyr Ser Glu Glu Gly Leu Lys Glu Phe Ile	
	115 120 125	
	AAG TTT TTA GAC GGT AAC AGA GAA CAA CTA ATA CGT GAT GTT GTT TCA	432
20	Lys Phe Leu Asp Gly Asn Arg Glu Gln Leu Ile Arg Asp Val Val Ser	
	130 135 140	
	ATG GAA GGT GAA AAA AAC GGA ATT CCT GTT GAG GTT GCA ATG GTG TAC	480
25	Met Glu Gly Glu Lys Asn Gly Ile Pro Val Glu Val Ala Met Val Tyr	
	145 150 155 160	
	AAT ACA TCA TAT TCA GAA AAT CTT CAC TCT TAC GTA AAT AAT ATT AAT	528
30	Asn Thr Ser Tyr Ser Glu Asn Leu His Ser Tyr Val Asn Asn Ile Asn	
	165 170 175	
	ACA CAT GAA GGT GGT ACA CAC CTT TCA GGT TTT AGA AGA GGT TTA ACA	576
35	Thr His Glu Gly Gly Thr His Leu Ser Gly Phe Arg Arg Gly Leu Thr	
	180 185 190	
	TCA ACC TTA AAA AAG TAT GCA GAT GCA TCT GGA ATG TTA GAC AAA TTA	624
40	Ser Thr Leu Lys Lys Tyr Ala Asp Ala Ser Gly Met Leu Asp Lys Leu	
	195 200 205	
	AAG TTT GAG ATT CAG GGA GAT GAT TTT AGA GAA GGT TTA ACG GCT ATT	672
45	Lys Phe Glu Ile Gln Gly Asp Asp Phe Arg Glu Gly Leu Thr Ala Ile	
	210 215 220	
	GTG TCT GTT AAA GTT GCA GAA CCT CAG TTT GAA GGG CAA ACA AAA ACT	720
50	Val Ser Val Lys Val Ala Glu Pro Gln Phe Glu Gly Gln Thr Lys Thr	
55		

EP 0 935 003 A2

	225	230	235	240	
5	AAA TTA GGT AAC AGA GAA GTT TCT TCT GCA GTG AGC CAA GCT GTA TCA	768			
	Lys Leu Gly Asn Arg Glu Val Ser Ser Ala Val Ser Gln Ala Val Ser				
	245	250	255		
10	GAA ATG CTT ACC AAC TAT TTA GAA GAA AAC CCA GAT GAT GCT AAG GTA	816			
	Glu Met Leu Thr Asn Tyr Leu Glu Glu Asn Pro Asp Asp Ala Lys Val				
	260	265	270		
15	ATT GTA CAA AAA GTC ATT TTG GCA GCG CAA GCA CGT CAT GCG GCT ACA	864			
	Ile Val Gln Lys Val Ile Leu Ala Ala Gln Ala Arg His Ala Ala Thr				
	275	280	285		
20	AAA GCC CGT GAA ATG GTA CAG CGT AAA ACG GTA ATG AGT ATA GGT GGT	912			
	Lys Ala Arg Glu Met Val Gln Arg Lys Thr Val Met Ser Ile Gly Gly				
	290	295	300		
25	TTA CCA GGG AAA TTA TCA GAC TGT TCT GAG CAA GAT GCT ACA AAA TGC	960			
	Leu Pro Gly Lys Leu Ser Asp Cys Ser Glu Gln Asp Ala Thr Lys Cys				
	305	310	315	320	
30	GAA GTA TTC CTT GTA GAG GGA GAT TCG GCG GGT GGT ACT GCT AAA CAA	1008			
	Glu Val Phe Leu Val Glu Gly Asp Ser Ala Gly Gly Thr Ala Lys Gln				
	325	330	335		
35	GGT AGG GAC AGA AAC TTT CAG GCA ATA TTA CCG CTT CGT GGT AAA ATC	1056			
	Gly Arg Asp Arg Asn Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile				
	340	345	350		
40	TTA AAT GTT GAA AAA GCA ATG CAA CAT AAG GTT TTT GAA AAC GAA GAA	1104			
	Leu Asn Val Glu Lys Ala Met Gln His Lys Val Phe Glu Asn Glu Glu				
	355	360	365		
45	ATA AAA AAT ATT TAC ACA GCT TTA GGT GTT ACT ATT GGT ACA GAA GAA	1152			
	Ile Lys Asn Ile Tyr Thr Ala Leu Gly Val Thr Ile Gly Thr Glu Glu				
	370	375	380		
50	GAT AGT AAA GCC TTA AAC TTA GAA AAA TTA AGA TAC CAT AAA GTA GTT	1200			

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EP 0 935 003 A2

Asp Ser Lys Ala Leu Asn Leu Glu Lys Leu Arg Tyr His Lys Val Val  
 385 390 395 400  
 ATT ATG TGT GAT GCC GAT GTA GAT GGT AGC CAC ATT GAA ACT TTA ATC 1248  
 Ile Met Cys Asp Ala Asp Val Asp Gly Ser His Ile Glu Thr Leu Ile  
 405 410 415  
 CTT ACA TTC TTC TTC CGT TTT ATG AGG GAG TTA ATA GAA GGC GGT CAC 1296  
 Leu Thr Phe Phe Phe Arg Phe Met Arg Glu Leu Ile Glu Gly Gly His  
 420 425 430  
 GTT TAT ATA GCA ACC CCA CCT TTA TAC TTG GTA AAA AAG GGA ACA AAA 1344  
 Val Tyr Ile Ala Thr Pro Pro Leu Tyr Leu Val Lys Lys Gly Thr Lys  
 435 440 445  
 AAA CGT TAT GCT TGG AAT GAT AAA GAA CGA GAT GAG ATA GCA GAA AGC 1392  
 Lys Arg Tyr Ala Trp Asn Asp Lys Glu Arg Asp Glu Ile Ala Glu Ser  
 450 455 460  
 TTT AAT GGT AGT GTT GGT ATA CAA AGA TAT 1422  
 Phe Asn Gly Ser Val Gly Ile Gln Arg Tyr  
 465 470

SEQ ID NO: 24  
 SEQUENCE LENGTH: 474  
 SEQUENCE TYPE: amino acid  
 TOPOLOGY: unknown  
 MOLECULE TYPE: protein  
 ORIGINAL SOURCE  
 ORGANISM: *Cytophaga lytica*  
 STRAIN: MBIC 1544

SEQUENCE DESCRIPTION  
 Asp Lys Asp Ser Tyr Lys Val Ser Gly Gly Leu His Gly Val Gly Val  
 1 5 10 15

EP 0 935 003 A2

Ser Cys Val Asn Ala Leu Ser Asn Asn Leu Lys Ala Thr Val Tyr Arg  
20 25 30  
5 Glu Gly Lys Ile Trp Glu Gln Glu Tyr Glu Arg Gly Lys Ala Leu Tyr  
35 40 45  
10 Pro Val Lys Ser Ile Gly Glu Thr Glu Glu Thr Gly Thr Ile Val Thr  
50 55 60  
Phe Tyr Pro Asp Asp Thr Ile Phe Thr Gln Thr Thr Glu Tyr Asn Tyr  
15 65 70 75 80  
Glu Thr Leu Ser Asn Arg Met Arg Glu Leu Ala Tyr Leu Asn Lys Gly  
85 90 95  
20 Val Thr Ile Ser Ile Thr Asp Lys Arg Val Lys Asp Glu Lys Gly Glu  
100 105 110  
Phe Leu Ser Glu Val Phe Tyr Ser Glu Glu Gly Leu Lys Glu Phe Ile  
25 115 120 125  
Lys Phe Leu Asp Gly Asn Arg Glu Gln Leu Ile Arg Asp Val Val Ser  
130 135 140  
30 Met Glu Gly Glu Lys Asn Gly Ile Pro Val Glu Val Ala Met Val Tyr  
145 150 155 160  
35 Asn Thr Ser Tyr Ser Glu Asn Leu His Ser Tyr Val Asn Asn Ile Asn  
165 170 175  
Thr His Glu Gly Gly Thr His Leu Ser Gly Phe Arg Arg Gly Leu Thr  
40 180 185 190  
Ser Thr Leu Lys Lys Tyr Ala Asp Ala Ser Gly Met Leu Asp Lys Leu  
195 200 205  
45 Lys Phe Glu Ile Gln Gly Asp Asp Phe Arg Glu Gly Leu Thr Ala Ile  
210 215 220  
Val Ser Val Lys Val Ala Glu Pro Gln Phe Glu Gly Gln Thr Lys Thr  
50 225 230 235 240  
Lys Leu Gly Asn Arg Glu Val Ser Ser Ala Val Ser Gln Ala Val Ser

55

EP 0 935 003 A2

	245	250	255
5	Glu Met Leu Thr Asn Tyr Leu Glu Glu Asn Pro Asp Asp Ala Lys Val		
	260	265	270
	Ile Val Gln Lys Val Ile Leu Ala Ala Gln Ala Arg His Ala Ala Thr		
10	275	280	285
	Lys Ala Arg Glu Met Val Gln Arg Lys Thr Val Met Ser Ile Gly Gly		
	290	295	300
15	Leu Pro Gly Lys Leu Ser Asp Cys Ser Glu Gln Asp Ala Thr Lys Cys		
	305	310	315
	Glu Val Phe Leu Val Glu Gly Asp Ser Ala Gly Gly Thr Ala Lys Gln		
20	325	330	335
	Gly Arg Asp Arg Asn Phe Gln Ala Ile Leu Pro Leu Arg Gly Lys Ile		
	340	345	350
25	Leu Asn Val Glu Lys Ala Met Gln His Lys Val Phe Glu Asn Glu Glu		
	355	360	365
	Ile Lys Asn Ile Tyr Thr Ala Leu Gly Val Thr Ile Gly Thr Glu Glu		
30	370	375	380
	Asp Ser Lys Ala Leu Asn Leu Glu Lys Leu Arg Tyr His Lys Val Val		
35	385	390	395
	Ile Met Cys Asp Ala Asp Val Asp Gly Ser His Ile Glu Thr Leu Ile		
	405	410	415
40	Leu Thr Phe Phe Phe Arg Phe Met Arg Glu Leu Ile Glu Gly Gly His		
	420	425	430
	Val Tyr Ile Ala Thr Pro Pro Leu Tyr Leu Val Lys Lys Gly Thr Lys		
45	435	440	445
	Lys Arg Tyr Ala Trp Asn Asp Lys Glu Arg Asp Glu Ile Ala Glu Ser		
	450	455	460
50	Phe Asn Gly Ser Val Gly Ile Gln Arg Tyr		
	465	470	

55

EP 0 935 003 A2

SEQ ID NO: 25

SEQUENCE LENGTH: 38

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAACAACGA CGGCCAGTCA YGCNGGNGGN AARTTYGA

38

SEQ ID NO: 26

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

His Ala Gly Gly Lys Phe Asp

1

5

SEQ ID NO: 27

SEQUENCE LENGTH: 36

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

CTGCGTTCGT ATATGAGCNC CRTCNACRTC NGCRTC

36

SEQ ID NO: 28

EP 0 935 003 A2

SEQUENCE LENGTH: 12

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Asp Ala Asp Val Asp Gly Ala His Ile Arg Thr Leu

1 5 10

SEQ ID NO: 29

SEQUENCE LENGTH: 41

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

GAAGTCATCA TGACCGTTCT GCAYGSNGGN GGNAARTTYG G 41

SEQ ID NO: 30

SEQUENCE LENGTH: 14

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Val Leu Met Thr Val Leu His Ala Gly Gly Lys Phe Gly

1 5 10

SEQ ID NO: 31

SEQUENCE LENGTH: 44

SEQUENCE TYPE: nucleic acid



EP 0 935 003 A2

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

AGCAGGGTAC GGATGTGCGA GCCRTCACR TCNGCRTCNG TGAT

44

SEQ ID NO: 32

SEQUENCE LENGTH: 15

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Met Thr Asp Ala Asp Val Asp Gly Ser His Ile Arg Thr Leu Leu

1

5

10

15

SEQ ID NO: 33

SEQUENCE LENGTH: 32

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

CAGGAAACAG CTATGACCAR RTGNGTNCCN CC

32

SEQ ID NO: 34

SEQUENCE LENGTH: 5

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

EP 0 935 003 A2

SEQUENCE DESCRIPTION

Gly Gly Thr His Leu

5

1

5

10

SEQ ID NO: 35

SEQUENCE LENGTH: 34

SEQUENCE TYPE: nucleic acid

15

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

20

SEQUENCE DESCRIPTION

GCAACGAGAT CAACACTCMN GARGGNGGNA CNCA

34

25

SEQ ID NO: 36

SEQUENCE LENGTH: 11

SEQUENCE TYPE: amino acid

30

TOPOLOGY: linear

MOLECULE TYPE: peptide

35

SEQUENCE DESCRIPTION

Asn Asn Ile Asn Thr His Glu Gly Gly Thr His

1

5

10

40

SEQ ID NO: 37

SEQUENCE LENGTH: 11

45

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

50

SEQUENCE DESCRIPTION

Asn Asn Ile Asn Thr Pro Glu Gly Gly Thr His

55

EP 0 935 003 A2

1 5 10

5

SEQ ID NO: 38

SEQUENCE LENGTH: 35

10

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

15

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAAACGA CGGCCAGTAR YTTNKYYTTN GTYTG

35

20

SEQ ID NO: 39

SEQUENCE LENGTH: 6

25

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

30

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Gln Thr Lys Thr Lys Leu

35

1

5

SEQ ID NO: 40

40

SEQUENCE LENGTH: 6

SEQUENCE TYPE: amino acid

45

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

50

Gln Thr Lys Asp Lys Leu

1

5

55

EP 0 935 003 A2

SEQ ID NO: 41

SEQUENCE LENGTH: 35

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TAGGCTAGCT GACCGTAAGA YGCNGAYRTN GAYGG

35

SEQ ID NO: 42

SEQUENCE LENGTH: 6

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Asp Ala Asp Val Asp Gly

1 5

SEQ ID NO: 43

SEQUENCE LENGTH: 36

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

CCATAGCTGC GTAGCATTCA TYTCNCCNAR NCCYTT

36

SEQ ID NO: 44

SEQUENCE LENGTH: 12

EP 0 935 003 A2

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Lys Gly Leu Gly Glu Met Asn Ala Thr Gln Leu Trp

1 5 10

SEQ ID NO: 45

SEQUENCE LENGTH: 41

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

CAGGAAACAG CTATGACCAA RMGNCCNGSN ATGTAYATHG G 41

SEQ ID NO: 46

SEQUENCE LENGTH: 8

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Lys Arg Pro Ala Met Tyr Ile Gly

1 5

SEQ ID NO: 47

SEQUENCE LENGTH: 8

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

EP 0 935 003 A2

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Lys Arg Pro Gly Met Tyr Ile Gly

1 5

SEQ ID NO: 48

SEQUENCE LENGTH: 38

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAAAACGA CGGCCAGTCC NCCNGCNSWR TCNCCYTC

38

SEQ ID NO: 49

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Gly Asp Ser Ala Gly Gly

1 5

SEQ ID NO: 50

SEQUENCE LENGTH: 39

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAAACGA CGGCCAGTCA TNGTNGTNTC CCANARYTG

39

5

SEQ ID NO: 51

10

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

15

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Gln Leu Trp Glu Thr Thr Met

20

1 5

SEQ ID NO: 52

25

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

30

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Gln Leu Trp Asp Thr Thr Met

35

1 5

SEQ ID NO: 53

40

SEQUENCE LENGTH: 41

SEQUENCE TYPE: nucleic acid

45

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

50

SEQUENCE DESCRIPTION

GAAGTCATCA TGACCGTTCT GCAYGCNGGN GGNAARTTYG A

41

55

EP 0 935 003 A2

SEQ ID NO: 54

SEQUENCE LENGTH: 14

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Val Ile Met Thr Val Leu His Ala Gly Gly Lys Phe Asp

1 5 10

SEQ ID NO: 55

SEQUENCE LENGTH: 14

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Val Ile Met Thr Val Leu His Ala Gly Gly Lys Phe Asn

1 5 10

SEQ ID NO: 56

SEQUENCE LENGTH: 14

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Val Ile Met Thr Val Leu His Ala Gly Gly Lys Phe Glu

1 5 10

SEQ ID NO: 57



EP 0 935 003 A2

SEQUENCE LENGTH: 14

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Glu Val Ile Met Thr Val Leu His Ala Gly Gly Lys Phe Lys

1 5 10

SEQ ID NO: 58

SEQUENCE LENGTH: 38

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAAACGA CGGCCAGTGC NGGRTCYTTY TCYTGRCA

38

SEQ ID NO: 59

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Cys Gln Glu Lys Asp Pro Ala

1 5

SEQ ID NO: 60

SEQUENCE LENGTH: 40

SEQUENCE TYPE: nucleic acid

EP 0 935 003 A2

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

GAAGTCATCA TGACCGTTCT GCAACNAAYA AYATHCCNCA

40

SEQ ID NO: 61

SEQUENCE LENGTH: 6

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Thr Asn Asn Ile Pro Gln

1 5

SEQ ID NO: 62

SEQUENCE LENGTH: 38

SEQUENCE TYPE: nucleic acid

STRANDEDNESS: single

TOPOLOGY: linear

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

TGTAAAACGA CGGCCAGTAA YTTNGGNTCN GGNACYTT

38

SEQ ID NO: 63

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

EP 0 935 003 A2

SEQUENCE DESCRIPTION

Lys Val Pro Asp Pro Lys Phe

5

1

5

SEQ ID NO: 64

10

SEQUENCE LENGTH: 7

SEQUENCE TYPE: amino acid

15

TOPOLOGY: linear

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

20

Lys Val Pro Glu Pro Lys Phe

1

5

25

SEQ ID NO: 65

SEQUENCE LENGTH: 35

SEQUENCE TYPE: nucleic acid

30

STRANDEDNESS: single

TOPOLOGY: linear

35

MOLECULE TYPE: other nucleic acid synthetic DNA

SEQUENCE DESCRIPTION

CAGGAAACAG CTATGACCGC NMRNMRNGCN MGNGA

35

40

SEQ ID NO: 66

SEQUENCE LENGTH: 6

45

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

50

SEQUENCE DESCRIPTION

Ala Arg Arg Ala Arg Glu

55

EP 0 935 003 A2

1 5

5

SEQ ID NO: 67

SEQUENCE LENGTH: 6

10

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

15

MOLECULE TYPE: peptide

SEQUENCE DESCRIPTION

Ala Arg Lys Ala Arg Glu

20

1 5

25

SEQ ID NO: 68

SEQUENCE LENGTH: 6

30

SEQUENCE TYPE: amino acid

TOPOLOGY: linear

MOLECULE TYPE: peptide

35

SEQUENCE DESCRIPTION

Ala Lys Lys Ala Arg Glu

40

1 5

45 **Claims**

1. A method for identifying a microorganism comprising

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(i) amplifying DNA from the microorganism by PCR using two primers, wherein at least one of the said primers comprises sequence which codes for all or part of one of the following amino acid sequences (a) to (f):

55

(a) (Pro or Ser)-(Ala or Thr)-(Ala, Val or Leu)-(Glu or Asp)-(Val or Thr)-(Ile or Val)-(Met, Leu or Phe)-Thr-(Val, Gln or Ile)-Leu-His-Ala-Gly-Gly-Lys-Phe-(Asp or Gly)-(Asp, Gly, Asn or Ser)-(Ser, Lys, Gly, Asp or Asn)

(b) Gly-Gly-Thr-His

(c) (Ile or Leu)-Met-Thr-Asp-Ala-Asp-Val-Asp-Gly-(Ala or Ser)-His-Ile-Arg-Thr-Leu

(d) Arg-Lys-Arg-Pro-(Gly or Ala)-Met-Tyr-Ile-Gly-(Ser or Asp)-Thr

(e) Gln-(Thr or Pro)-(Lys or Asn)-(Thr, Asp, Gly, Lys, Ser, Phe or Tyr)-Lys-Leu

- (f) (Tyr or Phe)-Lys-Gly-Leu-Gly-Glu-Met-Asn-(Ala or Pro)
- (g) Val-Glu-Gly-Asp-Ser-Ala-Gly-Gly-Ser
- (h) Lys-(His or Val)-Pro-Asp-Pro-(Gln or Lys)-Phe
- (i) Leu-Pro-Gly-Lys-Leu-Ala-Asp-Cys-(Ser or Gln)-(Ser or Glu)-(Lys or Arg)-Asp-Pro-(Ala or Ser)
- (j) Gln-Leu-(Trp or Arg)-(Glu or Asp)-Thr-Thr-(Met or Leu)-(Asp or Asn)-Pro
- (k) Ala-(Lys or Arg)-(Lys or Arg)-Ala-Arg-Glu
- (l) Phe-Thr-Asn-Asn-Ile-(Pro or Asn)-(Thr or Gln)

and which functions as a substantial primer; and  
 (ii) identifying the microorganism based on the nucleotide sequence of the amplified DNA fragment.

2. A method for detecting a microorganism comprising

(i) amplifying DNA from a sample by PCR using two primers, wherein at least one of the said primers comprises sequence which codes for all or a part of one of the following amino acid sequences (a) to (l):

- (a) (Pro or Ser)-(Ala or Thr)-(Ala, Val or Leu)-(Glu or Asp)-(Val or Thr)-(Ile or Val)-(Met, Leu or Phe)-Thr-(Val, Gln or Ile)-Leu-His-Ala-Gly-Gly-Lys-Phe-(Asp or Gly)-(Asp, Gly, Asn or Ser)-(Ser, Lys, Gly, Asp or Asn)
- (b) Gly-Gly-Thr-His
- (c) (Ile or Leu)-Met-Thr-Asp-Ala-Asp-Val-Asp-Gly-(Ala or Ser)-His-Ile-Arg-Thr-Leu
- (d) Arg-Lys-Arg-Pro-(Gly or Ala)-Met-Tyr-Ile-Gly-(Ser or Asp)-Thr
- (e) Gln-(Thr or Pro)-(Lys or Asn)-(Thr, Asp, Gly, Lys, Ser, Phe or Tyr)-Lys-Leu
- (f) (Tyr or Phe)-Lys-Gly-Leu-Gly-Glu-Met-Asn-(Ala or Pro)
- (g) Val-Glu-Gly-Asp-Ser-Ala-Gly-Gly-Ser
- (h) Lys-(His or Val)-Pro-Asp-Pro-(Gln or Lys)-Phe
- (i) Leu-Pro-Gly-Lys-Leu-Ala-Asp-Cys-(Ser or Gln)-(Ser or Glu)-(Lys or Arg)-Asp-Pro-(Ala or Ser)
- (j) Gln-Leu-(Trp or Arg)-(Glu or Asp)-Thr-Thr-(Met or Leu)-(Asp or Asn)-Pro
- (k) Ala-(Lys or Arg)-(Lys or Arg)-Ala-Arg-Glu
- (l) Phe-Thr-Asn-Asn-Ile-(Pro or Asn)-(Thr or Gln)

and which functions as a substantial primer; and  
 (ii) identifying whether the sample comprises a microorganism based on the nucleotide sequence of any amplified DNA fragments.

3. A method according to claims 1 or 2, wherein step (i) comprises: amplifying DNA from the microorganism or sample by PCR using two primers, wherein:

the first of the said primers comprises sequence which codes for all or part of one of the amino acid sequences (a) to (l); and  
 the second of the said primers comprises sequence which is the reverse complement of sequence which codes for all or part of a different one of amino acid sequences (a) to (l).

4. A method according to claim 3, wherein the first primer comprises sequence which codes for all or part of amino acid sequence (a) and the second primer comprises sequence which is the reverse complement of sequence which codes for all or part of amino acid sequence (b), (c), (e), (h), or (l).

FIG. 1

(d)

GYRB BACSU MEQQQNSYDENQIQVLEGLEAVRKRPGMYIGSTNS-KGLHHLVWEIVDNSIDEALAGYCT  
 GYRB ECOLI ----SNSYDSSSIKVLKGLDAVRKRPGMYIGTDDGTGLHHMVFEVVDNAIDEALAGHCK  
 GYRB PSEPU -MSENQTYDSSSIKVLKGLDAVRKRPGMYIGTDDGSGLHHMVFEVVDNSIDEALAGHCD

(a)

GYRB BACSU DINIQIEKDNSITVVDNNGRGI PVGIHEKMGRPAVEVIMTVLHAGGKFDGSGYKVSGLHG  
 GYRB ECOLI EIIVTIHADNSVSQDDGRGIPTGIHPEEGVSAAEVIMTVLHAGGKFDDNSYKVSGLHG  
 GYRB PSEPU DITVIIHTDESISVRDNGRGI PVDVHKEEGVSAAEVIMTVLHAGGKFDDNSYKVSGLHG

GYRB BACSU VGASVVNALSTELDVTVHRDGIHRQTYKRGVPTDLEIIGETDHTGTTTHFVPDPEIFS  
 GYRB ECOLI VGVSVVNALSQKLELVIQREGKIHRQIYEHGVPQAPLAVTGETEKTGTMVRFWPSLETFT  
 GYRB PSEPU VGVSVVNALSEKLVLTVRRSGKIWEQTYVHGVPQAPMAVVGESSETTGTHIFKPSAETFK

GYRB BACSU ETTEYDYDLLANRVRELAFLTKGVNITIEDKREGQERKNEYHYEGGIKSVEYLNRSKEV  
 GYRB ECOLI NVTEFEYEILAKRLRELSFLNSGVSIRLRDKRDGKE--DHFHYEGGIKAFVEYLNKNKTP  
 GYRB PSEPU N-IHFSWDILAKRIRELSFLNSGVGILLKDERSGKE--EFFKYEGGLRAFVEYLNNTKTP

(1) (b)

GYRB BACSU VHEEPIYIEGEK-DGITVEVALQYNDSTSNISYFTNNINTYEGGTHEAGFKTGLTRVIN  
 GYRB ECOLI IHPNIFYFSTEK-DGIGVEVALQWNDGFQENIYCFNNIPQRDGGTHLAGFRAAMRTLN  
 GYRB PSEPU VNSQVFHFSVQREDGVGVEVALQWNSFNENLLCFTNNIPQRDGGTHLVGRSSSLTRSLN

(h) (e)

GYRB BACSU DYARKKGLIKENDPNLSGDDVREGLTAIISIKHPDPQFEGQTKTKLGNSEARTITDTLFS  
 GYRB ECOLI AYMDKEGYSKKAKVSATGDDAREGLIAVSVKVPDPKFSSQTKDKLVSEVKSASVEQOMN  
 GYRB PSEPU SYIEQEGGLAKKNKVATTGDDAREGLTAIISVSVKVPDPKFSSQTKDKLVSEVKTAVEQEMN

(k) (i)

GYRB BACSU TAMETFMLENPDAKKIVDKGLMAARARMAAKKARELTRRKSALISNLPGLADCSSKD  
 GYRB ECOLI ELLAEVYLLNPDAKIVVGKIIDAARAREAAARRAREMTRRKGAIDLGLAGLPGKLADCOERD  
 GYRB PSEPU KYFSDFLENPNEAKAVVGKMDAARAREAAARKAREMTRRKGAIDLGLAGLPGKLADCOERD

(g)

GYRB BACSU PSISELYIVEGDSAGGSAKQGRDRHFQAILPLRGKILNVEKARLDKILSNNEVRSMITAL  
 GYRB ECOLI PALSELYLVEGDSAGGSAKQGRNRKNQAILPLKGIILNVEKARFDKMLSSQEVATLITAL  
 GYRB PSEPU PALSELYLVEGDSAGGSAKQGRNRRTQAILPLKGIILNVEKARFDKMISSQEVGTLITAL

(c)

GYRB BACSU GTGIGED-FNLEKARYHKVVIMTDADVDGAHIRTLLLTFFFYRMYRQIIENGYYIAQPPL  
 GYRB ECOLI GCGIGRDEYNPDKLRYSIIIMTDADVDGSHIRTLLLTFFFYROMPEIVERGHVYIAQPPL  
 GYRB PSEPU GCGIGREEYNIDKLRYSNIIIMTDADVDGSHIRTLLLTFFFRQLPELVERGYIYIAQPPL

GYRB BACSU YKVQQK-----  
 GYRB ECOLI YKVKKGQEQYIKDDEAMDOYQISIALDGATLHTNASAPALAGEALEKLVSEYNATOKMI  
 GYRB PSEPU YKVKKGQEQYIKDDEAMEEYMTQSALEDASLHLDSEAPAVSGVQLESVNEFRSVMKTL

GYRB BACSU -RVEYAY-----NDKE-----  
 GYRB ECOLI NRMERRYPKAMKELIYQPTLTEADLSDEQTVTRWVNALVSELNDKEQHSQWKFVHTN  
 GYRB PSEPU KRLSRLYPEELTEHFVYLPVTTLEQLGDHAVMQAWLAKLQERLNSQKSGLAYNASLRED

GYRB BACSU -----  
 GYRB ECOLI AEQNLFEPIVRVTRTHGVDTDYPLDHEFITGGEYRRICTLGEKLRGLLEDAFIERGERRQ  
 GYRB PSEPU KERNVWLPEVEITSHGLASYITFNDRDFGSDNYRTVVNIGAKLSSLLGEGAYVQRGERRK

(f) (j)

GYRB BACSU ----LEELLKTLPTPKP--GLORYKGLGEMNATQLWETTMDPSSRTLLQVTTLEDAMDAD  
 GYRB ECOLI PVASPEQALDWLVKESRRGLSIQRYKGLGEMNPEQLWETTMDPESRRMLRVTVKDAIAAD  
 GYRB PSEPU AIVEFKEGLDWLMNETTKRTHIQRYKGLGEMNPDQLWETTMDPVRRMLKVTIEDAIAAD

GYRB BACSU ETFEMLMGDKVEPRRNFIENARYVKNLDI  
 GYRB ECOLI QLFTTLMGDAVEPRRAFIEENALKAANIDI  
 GYRB PSEPU QIFNTLMGDAVEPRREFIESNALSVSNLDF

(19)



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EP 0 935 003 A3

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(54) **Method for identification and detection of microorganisms using gyrase gene as an indicator**

(57) A method for identifying a microorganism, comprises

(i) amplifying DNA from the microorganism by PCR using two primers, wherein at least one of the said primers comprises sequence which codes for all or part of one of the following amino acid sequences (a) to (l):

- (a) (Pro or Ser)-(Ala or Thr)-(Ala, Val or Leu)-(Glu or Asp)-(Val or Thr)-(Ile or Val)-(Met, Leu or Phe)-Thr-(Val, Gln or Ile)-Leu-His-Ala-Gly-Gly-Lys-Phe-(Asp or Gly)-(Asp, Gly, Asn or Ser)-(Ser, Lys, Gly, Asp or Asn)
- (b) Gly-Gly-Thr-His
- (c) (Ile or Leu)-Met-Thr-Asp-Ala-Asp-Val-Asp-Gly-(Ala or Ser)-His-Ile-Arg-Thr-Leu
- (d) Arg-Lys-Arg-Pro-(Gly or Ala)-Met-Tyr-Ile-Gly-(Ser or Asp)-Thr
- (e) Gln-(Thr or Pro)-(Lys or Asn)-(Thr, Asp, Gly, Lys, Ser, Phe or Tyr)-Lys-Leu

(f) (Tyr or Phe)-Lys-Gly-Leu-Gly-Glu-Met-Asn-(Ala or Pro)

(g) Val-Glu-Gly-Asp-Ser-Ala-Gly-Gly-Ser

(h) Lys-(His or Val)-Pro-Asp-Pro-(Gln or Lys)-Phe

(i) Leu-Pro-Gly-Lys-Leu-Ala-Asp-Cys-(Ser or Gln)-(Ser or Glu)-(Lys or Arg)-Asp-Pro-(Ala or Ser)

(j) Gln-Leu-(Trp or Arg)-(Glu or Asp)-Thr-Thr-(Met or Leu)-(Asp or Asn)-Pro

(k) Ala-(Lys or Arg)-(Lys or Arg)-Ala-Arg-Glu

(l) Phe-Thr-Asn-Asn-Ile-(Pro or Asn)-(Thr or Gln)

and which functions as a substantial primer; and  
(ii) identifying the microorganism based on the nucleotide sequence of the amplified DNA fragment

EP 0 935 003 A3

EP 0 935 003 A3



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# EUROPEAN SEARCH REPORT

Application Number  
EP 98 31 0224

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X	DATABASE WPI Week 9541 Derwent Publications Ltd., London, GB; AN 95-315932 XP002113794 "Identify detect microbe DNA gene sequence allow more accuracy define microbe strain species" & JP 07 213299 A (KAIYO BIOTECHNOLOGY KENKYUSHO KK), 15 August 1995 (1995-08-15) * abstract *	1-4	C12Q1/68 C12N15/90
X	US 5 645 994 A (HUANG WAI MUN) 8 July 1997 (1997-07-08) see Seq ID 101 of citation with respect to sequence (d) of claim 1.	1-4	
A	WO 97 35970 A (DOUMOTO NOBUHIKO ;KASTHURI VENKATESWARAN (JP); NIPPON SUISAN KAISH) 2 October 1997 (1997-10-02)		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 31 August 1999	Examiner Osborne, H
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... &amp; : member of the same patent family, corresponding document</p>			

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EP 0 935 003 A3

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82